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ELECTRICAL EXPORT TRADE.

The general conditions of electrical export trade continue satisfactory as revealed by the figures for October. It would appear that for the ten months ending with October this year the total electrical exports were $14,864,463 as compared with $13,813,822 in 1906. This is a gain of over $1,000,000. It was all in heavier electrical machinery, as instruments fell off about $140,000, while machinery increased from $7,010,068 to $8,197,143.

The details for October itself bear more direct evidence of the slackening noted during the second half of the year. Electrical machinery for the month increased from $743,749 to $767,016 and electrical apparatus and instruments fell off from $863,287 to $690,898. It will thus be seen that the ten months' loss in apparatus is concentrated wholly in October. But it is to be borne in mind that October in 1906 gave some very excellent and exceptional figures, far above the monthly average. The loss was again almost wholly in shipments to the United Kingdom, the falling off being from $222,900 down to the remarkably small amount of $54,161. On the other hand, Brazil showed a gain from $51,896 to $174,057. In heavy electrical machinery, the gains were well distributed for the month and period, but Mexico made a big jump of $120,000 for the month and nearly half a million for the ten months. In other words, there is all around encouragement for the pushing of trade abroad, on the lower range of prices.

ANNUAL REPORT OF THE BRITISH INSTITUTION OF ELECTRICAL ENGINEERS.

The report of the Council of the Institution of Electrical Engineers for the year ending in 1907, suggests some interesting comparisons between the Institutions of Electrical Engineers in England on the one hand, and in the United States on the other. In regard to membership, the English Institution still maintains the lead, its total membership being 5945 in 1907, as against some 5100 in the American Institute. On the other hand, the British membership is growing at the rate of only 2½ per cent per annum, whereas the American membership list is growing at a much more rapid rate, so that the American list seems likely to overtake the British list in the near future. In London, the membership is divided with a fair degree of uniformity between members, associate-members, associates and students; whereas, with us, only about one-eighth of the list consists of members, a somewhat similar fraction being students, while the bulk of the list consists of pure associates. Each of the Institutions maintains branches. In the British Institution five are in the British Islands and one in South Africa. In the American Institute there are more than 30 branch organizations, one of which is in Toronto.

The British Institution dispensed no less than nine annual premiums, in addition to five students' premiums. Since there were only fourteen papers read during the year, it is evident

that a large percentage of papers may reasonably expect to meet with a premium. If there were only a few more premiums annually awarded, it might be hard for an author to avoid receiving such an award. Nevertheless, the annual premium, within due limitations, no doubt constitutes a valuable incentive and index to the value of papers contributed. This feature might be adopted with advantage by the American Institute. The British Institution publishes, as an appendix to its report, a useful list of technical proceedings and journals kept on file in its library. Of these, among foreign transactions, 14 are from the United States, 7 from France, 5 from Germany, 3 from Canada, and 7 others collectively among Belgium, Holland, Italy, Russia and Sweden. Among foreign technical periodicals, 15 are from America, 17 from Germany, 10 from France, 4 from Italy and 6 others in all, from Austria, Denmark, Holland, Spain and Switzerland. If we assume that all the important publications from each country are kept on file, it follows that American representation is well maintained. A perusal of the report brings into clear recognition the fact that national engineering organizations are not only potent factors for national development, but also powerful forces directed to international cooperation.

Spark Coils.

We are glad to present to our readers Professor Springer's paper (page 1163) on the design and operation of spark coils. The whole subject is a somewhat intricate one which has been much neglected, and Professor Springer's comparatively simple analysis of the problem is most timely. The fundamentals of spark coil design are to produce a spark carrying the requisite energy and to do it at the smallest practicable outlay of energy, if the source of supply is a battery. When a magneto is used for ignition the output is of secondary importance, since the energy delivered by the machine is generally small with respect to the constant losses, and from any point of view is insignificant. The starting point is then output of energy in the spark necessary to secure good ignition. This is certainly rather variable according to the design and location of the spark plug and the circumstances of its use. For the ordinary four-cycle engine with gasoline as fuel, Professor Springer estimates the required energy in a touch-spark as 0.04 watt-second, running up to 0.1 watt-second in starting. The energy required with the more common jump-spark he does not state, save that in general it may be rather less than with a touch-spark, since the latter gets but one try at ignition as against several given by the vibrator. Obviously, however, it is advantageous to make each spark powerful enough to do the work, else the timing in a fast-running engine will be uncertain. An engine running at 20 or so revolutions per second cannot wait long for an effective spark.

Given the energy required in the spark, one can go about providing it intelligently, since this energy must be stored in the circuit and is directly proportional to the inductance and to the current squared. Professor Springer's equations give simple means of calculating from this requirement the relations of inductance, resistance and e. m. f. of supply desirable in any particular case. An examination of the conditions shows immediately the way in which the requirements for good service are constantly violated. A given coil requires for maximum effect a particular value of the applied e. m. f. at its terminals. If this is not available, either from too few cells or cells of too high resistance, there is bound to be trouble. An increase in current fattens the spark, it is true, but runs out the battery and may put the vibrator out of action or even damage the insulation of the coils. For battery work it is desirable to work the cells as efficiently as possible to secure long life, and this demands arranging the battery to suit the particular coil it is to operate. If one takes any convenient coil and the first battery he can lay his hands on, he has no reason to complain if the results are downright bad. Professor Springer goes at some length into the general characteristics of induction-coil design with respect to the size and shape of core, details which are both theoretically and practically interesting. Touch-spark coils and non-vibrating jump-spark coils require somewhat different design from coils to be used with vibrators, while the former two also have distinctive differences. The vital point in coils of the ordinary type is the vibrator, on which depends the sharpness of the break and the effectiveness of the resulting spark. The condenser also must be exactly proportional to the coil and its vibrator in order to give the best action.

In view of the investigation reported by Professor Springer it is time for coil builders to bestir themselves and to produce coils which have definite characteristics and known conditions of maximum efficiency. The sparking apparatus is vital in its importance and ought to be worked out with the utmost pains. The requirements in automobile work are particularly severe on account of the increasing demand for output at the battery and the lack of reliable batteries. It is not so much that the batteries are poor, as that they are often ill-adapted to the particular work demanded of them. It ought to be possible by careful design to produce a sparking system really suited to the required work, and making much less severe demand on the batteries than the helter-skelter combinations too frequently found. The saving in zinc might not be much, but the lessened wear and tear upon the disposition would be worth the price.

The "Concentric" Method of Teaching Electrical Engineering.

One of the papers read before the last convention of the American Institute of Electrical Engineers was on the so-called "concentric" method of teaching electrical engineering, by Prof. V. Karapetoff. In brief, the gist of this method consists in making outline courses on broad engineering methods precede the auxiliary sciences of mathematics, mechanics, chemistry and physics. In regard to teaching, as in regard to individual tastes, there is no complete agreement in detail. If we can agree on broad principles, we should be content. This is a necessary consequence of the fact that no two individual instructors have the same mental methods, or mental standpoints; and moreover, no two students have the same mental methods, equipments, experiences or receptiveness. All that can be hoped for in any educational establishment is such a course of studies as may be adapted to the average individual student, so that the best general result may be secured. The paper here considered will no doubt meet with assent, so far at least, as the proposition that students should not be forced to take preparatory courses in engineering when the subjects of these courses are purely theoretical and entirely remote from

practical applications. The reasons for this belief are not merely that such theory is not proper training for a man who is to have practical life work, but also that the interest of the student is seldom aroused by such abstract study; and unless the student's interest can be excited and maintained, the educational value of any course of study can be but little.

All will probably agree that an engineer should receive a good general training for the practical management of machinery, with an adequate knowledge of the laws and properties of the same, and should be trained in such a manner that his mind will be interested, aroused and normally developed by regular exercise. Differences of opinion arise as to the best method of securing this training. The difficulty with the method defined in the paper here considered is that the preliminary outline of engineering studies, entered upon before mathematics, mechanics and physics have been developed, may become so elementary and descriptive as to be almost popular discourses, and not call for sufficient mental effort from the student, however much they may interest and divert him. This is just the opposite extreme to the system held up to criticism by the paper—that is, long, difficult courses which seem to have no useful applications, which call for much mental labor but which do not produce the requisite mental development owing to lack of stimulus and interest. It really makes very little difference as to the course of study nominally followed, if the mode of treatment be properly selected. In the hands of good instructors, mathematics, mechanics, physics and chemistry for engineering students may be full of applications, replete with practical interest, and of stimulus to the student. On the other hand, in the hands of good instructors the outline concentric engineering courses recommended by the paper would contain ample material for mental application. In either case if the methods used are imperfect the results will be defective—in the concentric method due probably to vapidity, in the ordinary method, due probably to sterility. In teaching, it is as in soldiering, sailoring or any other walk in life; the individual men who carry on the business are of more consequence than the names of the methods they adopt.

It appears to us that, until a differentiation is made in technical education to accord with the widely different careers which are open to graduates, no entirely satisfactory system of instruction can be formulated. As it is, the course which would best meet the views of the manufacturer might be thought quite defective by the consulting engineer or central-station manager; and most parents will patronize that course which promises, through its practical training, a wage-earning status upon graduation, and will consider too "theoretical" a course which imparts only the principles upon which subsequent engineering practice must be based. The present-day system of technical education seems, in fact, to be largely a compromise to meet divergent lay views having an influence on college enrollment, and its discussion under these circumstances along purely educational lines cannot be otherwise than somewhat academic until the differentiation above referred to takes shape as a policy. This stage of evolution has already been reached in Germany, France and other European countries, where different classes of schools solve the problem now before those American colleges which endeavor, by means of a single course, to turn out men equally fitted not only for every grade of engineering work from designing engineer to generating room attendant, but also for the quasi-technical and non-technical positions which the electrical industry holds open to graduates.

Ionization in Air Within Closed Metallic Vessels.

Dry air, although electrically brittle, and not capable of withstanding much electric stress, is nevertheless perhaps the best insulating substance we know of, and fortunately there is plenty of it gratis. Text books on electricity, only a few years old, put air not only at the head of the list of insulating substances, but also as of infinite resistivity. Whenever an air-insulated brass sphere, supported, say, by a quartz fiber, was observed to lose its electric charge, the leak was always attributed to the imperfections of the quartz thread, and not to the unblemished air, in much the same fashion as the old doctrine that a king could do no wrong, but occasionally a prime minister, acting on a king's order, might do enough wrong to undergo capital punishment. More recent investigations concerning the insulating properties of air, especially since the discovery of radium emanation, have led to the unavoidable conclusion that air, after all, does leak electrically, even under very low pressures. It is now supposed that molecules of air are not the delinquents in the process of leakage, but that disrupted molecules carry off the electrical charge. It is also believed that a number of agencies may disrupt air molecules, or ionize them, into positive and negative individual atomic constituents. Among these agencies are radium, ultra-violet light, and high electric stresses producing high molecular velocities. On this theory, a spark discharge may be popularly regarded as ionization run wild, hordes of quiet, respectable neutral air-molecules having been very suddenly bombarded into disruption, and the divorce of positive and negative ionic constituents that rush like so many charged pithballs to carry on an electric discharge. Beyond a certain intensity in electric stress, nothing produces ions in air so rapidly as other ions, the collisions of these little active pithballs knocking the union and sobriety out of many neighboring molecules. Below this critical value of electric stress, the collision velocities are insufficient to affect much molecular instability, and the number of free ions per cubic centimeter of air is very small. In spite of all precautions, however, there are always a few ions present in air, even when the air is inside a metal chamber with thick walls.

The last number of *The Physical Review* contains a paper by T. Frederick McKeon on the variation of ionization in air. The results described in the paper show that the air contained between two large metallic cylinders, kept sealed and undisturbed, undergoes a steady change either of increase or decrease of ionization, associated with a periodic change making one cycle in 12 hours or two cycles a day, like the ocean tides. Whereas, however, the tide cycle is about 12 hours and 26 minutes, the ionization cycle within these closed metallic vessels was apparently not to be distinguished from 12 hours, suggesting, therefore, solar, rather than lunar influence. The maxima occurred shortly before noon and midnight, but these maxima did not develop at precisely corresponding times daily. The periodic change was noticeable, no matter what the metal from which the cylinders were constructed. It is suggested that the effect is due to the sun's light ionizing the earth's atmosphere, and so shifting the earth's electric field twice daily.

The New British Patent Law.

A new patent and designs act comes into force in Great Britain on Jan. 1, 1908. There are various changes of importance in the law, of which an abstract reaches us from Mr. Ernst Zappert, of London.

The Comptroller of the Patent Office may require samples and specimens to be furnished before the complete specification is accepted. The Comptroller may refuse to grant a patent if he is satisfied that an invention has been wholly and specifically claimed in any specification to which the official investigation has extended. Such refusal is subject to appeal which may be made to the law officer.

The period within which a sealing fee should be paid may be extended to such time as may be prescribed. This condition is applicable to patents which have lapsed owing to the omission to pay the sealing fee within the proper time prior to the commencement of the Act.

Where an applicant has made application for two or more patents, with provisional specifications, and which are modifications one of the other, and the Comptroller is of opinion that the whole of such inventions are such as to constitute a single invention, he may accept one complete specification in respect of the whole of such applications and grant a single patent thereon. In this case the patent will bear the date of the earliest application. This is important to inventors, and it is obvious that as the cost of provisional protection is but a small part of the cost of a patent, an inventor can put in a provisional specification for a new idea, and, as the invention develops, add further provisional specifications from time to time during the term of provisional protection, finally covering the whole by one complete specification.

A patentee under the new act will have the privilege of applying for a Patent of Addition for any improvements or modifications for which he has already obtained a patent, but such patent of addition will expire with the original patent. He will have the advantage, however, of having to pay only one set of renewal fees. This is an addition to the English law very similar to the conditions applying to patents in France, Germany and some other countries, where patents of addition have long been granted.

Where a patent has become void owing to the non-payment of fees, the Comptroller may in certain cases restore the patent. It must be shown that the omission to pay the renewal fees was unintentional and no undue delay must occur in applying for the patent to be restored.

In addition to the grounds hitherto existing a patent may now be revoked if it is shown that the reasonable requirements of the public with respect to a patented invention have not been satisfied, but such revocation will not be made before the expiration of three years from the date of the patent, or if the patentee gives satisfactory reasons for his default in not working the patent, etc. The Comptroller may also revoke a patent upon the application of any person who would have been entitled to oppose the grant of the patent, and upon any of the grounds upon which it might have been opposed, but such application must be made within two years of the date of the patent.

A patent may also be revoked if it is proved that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom. Application for revocation upon this ground may be made after four years from the date of the patent, but not less than one year after the passing of the act. Unless the year and number of the patent are applied to the patented article, notice is not deemed to have been given of the existence of a patent.

Subject to any contract to the contrary, where a patent is granted to two or more persons, each of such persons is entitled to use the invention for his own profit without accounting to others, but is not entitled to grant a license without their consent. In case of the death of one of joint patentees his beneficial interest in the patent will go to his personal representatives as part of his personal estate.

Opportunities in the U. S. Civil Service.

The United States Civil Service Commission announces an examination, open to American citizens, on Jan. 8, 1908, at the places mentioned, to secure eligibles from which to make certification to fill the following-named vacancies, and vacancies as they may occur in the Indian Service in the engineering positions indicated below: Engineer, $720 per annum, Mescalero Agency, N. M. The person to be appointed to this position should be qualified to operate steam engines, boilers, pumps, dynamos and electric light apparatus. Examination in branches 1 and 2 is required for this position. Engineer, $720 per annum, Zuni School, N. M. The person appointed to this position should be qualified to operate boilers, steam engines and pumps. Examination in branch 1 is required for this position. Engineer, $720 per annum, Riverside School, Okla. The person appointed to this position should be qualified to operate steam engines, boilers, pumps, a steam-heating plant, etc., and should have had experience in the management of electric light apparatus. Examination in branches 1 and 2 is required for this position. Assistant engineer, $720 per annum, Salem School, Ore. The person appointed to this position should be qualified to operate boilers, steam engines, pumps, dynamos and electric light apparatus, and a steam-heating plant. Examination in branches 1, 2, and 3 is required for this position.

Owing to the widely varying conditions in the various schools and agencies of the Indian Service general engineering examinations will be given under the following separate branches. An applicant may take one or more than one of these in his discretion. The prospects of appointment will be increased by successfully passing more than one of the branches indicated. Applicants should fully indicate in their applications the particular branch or branches in which they desire to be examined, and should state as definitely as possible the experience they have had which would tend to qualify them in the branches selected.

The salaries are $480 to $1,000 per annum. The majority of the appointments, however, are made at salaries of $720, $840 and $900 per annum. The age limit is 20 years or over on the date of the examination. Two days will be required in case more than three branches are taken. Application should be made at once for forms, etc., to the U. S. Civil Service Commission at Washington, or to the local boards. A synopsis of the branches of examination is given below:

Branch 1, steam engineering; time allowed, 3 hours. Subjects: 1. Practical questions (covering installation, repair and operation of boilers and steam engines, and pumps) 60. 2. Experience in handling steam engines and boilers and pumps (rated on application) 40. Total, 100 marks.

Branch 2, electrical engineering; time allowed, 3 hours. Subjects: 1. Practical questions (covering generators and motors, switchboard apparatus, wiring for lamps and motors) 60. 2. Experience in handling electrical apparatus (rated on application) 40. Total, 100 marks.

Branch 3, heating; time allowed, 2½ hours. Subjects: 1. Practical questions (covering heating by hot water and exhaust or live steam) 60. 2. Experience in handling heating plants (rated on application) 40. Total, 100 marks.

Branch 4, refrigeration; time allowed, 2½ hours. Subjects: 1. Practical questions (covering systems of refrigeration and operation of necessary apparatus) 60. 2. Experience in handling refrigerating apparatus (rated on application) 40. Total, 100 marks.

Branch 5, gas and gasoline engines; time allowed, 2 hours. Subjects: 1. Practical questions (covering operation of gas and gasoline engines) 60. 2. Experience in handling gas and gasoline engines (rated on application) 40. Total, 100 marks.

Branch 6, hydraulics; time allowed, 2 hours. Subjects: 1. Practical questions (covering operation of water turbines and water wheels) 60. 2. Experience in handling turbines and water wheels (rated on application) 40. Total, 100 marks.

Electrical Monopoly in Germany.

According to advices from Berlin, a project for the creation of a State monopoly in electricity is mooted by the local correspondent of the *Magdeburger Zeitung,* who, as is well known, is in close touch with the Government, and is frequently employed as the medium by which official views are conveyed to the German public. Whether he is inspired on this occasion from any official source, or by influential members of the National Liberal Party, or whether his communication be a *ballon d'essai* is not known. The proposal, which is elaborated with considerable detail in the columns of the *Magdeburger Zeitung,* may be summed up briefly as the nationalization of the production and distribution of electricity. The following extracts reveal the drift of the arguments in favor of the project:

"We are face to face to-day with the inauguration of a period in which electricity will become the most important factor in our whole industrial system. We can say, in the light of scientific research, as well as of practical experience, that all indications point to the necessity of centralizing motor powers. We are convinced that the era of electricity which we are approaching will compel the nation to organize a systematic exploitation of the natural sources of electricity, such as mountains and streams, as well as the systematic distribution of electrical motor power. We believe the Imperial Government ought to distribute electrical motor power for the common welfare.

"We consider that it would be a truly Imperial task to supply electricity to the gigantic machines of ships, railways and factories, as well as to the small workshops of independent artisans. It is superfluous to describe in detail all the far-reaching consequences of the nationalization of electricity, but we may point out that the State monopoly of electricity would be more than a mere financial reform. We have no illusions regarding the innumerable difficulties necessary to be overcome before the scheme could be realized. None but a political Hercules could realize it, but it is a case of 'now or never.' The time is ripe for the centralization of electrical motor powers."

The *Magdeburger Zeitung* argues glibly that the financial profits accruing to the Imperial Government from a State monopoly of electricity would relieve Germany from her present financial embarrassments, and remove the necessity of imposing new indirect taxation, and thereby causing new and widespread discontent.

Legal Right to Telephonic Privacy.

Justice Lynn, in New York City, delivered a decision recently that is causing a great deal of discussion, and that even if appealed must be conceded to put the right to telephonic privacy in a strong light. It appears that the wife of the superintendent of an apartment house had her own line cut in frequently on that of a tenant so as to overhear the conversation and then discussed publicly what she had heard. Under these circumstances the tenant, not getting redress, threw up his lease and left the place. The landlord sued for his four months' rent and has been non-suited. The justice in his decision says: "It is contended by the landlord that his superintendent was not guilty of these acts, but I find as a matter of fact * * * that this superintendent was guilty of this unusual act of listening or what might be properly called eavesdropping over the telephone, and learning what was said by various people to this lady, and took opportunity of giving expression at different times in the hallway of this apartment house, announcing that the tenant was a woman having other loyalties than her husband and intimating that her morals were not of that kind or character to warrant her remaining in that house."

The justice regards the telephone as a sort of wired extension of the privacy of the home. Of the instrument in general he says: "It has passed the period of experiment and is now a real living part of ourselves. It expresses the soul and mind of our feelings; the heart throbs of the human voice are felt as keenly over this instrument as when one person talks to another, and it can express its intonations and throbs when reflected by the human voice; and where it is installed as a part of an apartment house and made an inducing cause for the rental of such apartment, then its presence must be regarded as a sacred part of the home, entering into its privacies and secrets and giving communion with those we love and cherish. When such abuse is made of it as was made by the plaintiff's agents in this case, then I hold that as a matter of law it is a deprivation of the peace and quietness with which our common law surrounds every household; it is an invasion of the domicile worse than eavesdropping, more vicious than scandal, and more detrimental to the welfare of the home-dweller than any other ordinary abuse a landlord is capable of heaping upon a tenant."

Electric Transportation in Buenos Aires.

Having a population exceeding 1,100,000, Buenos Aires is the largest Latin city in the world, except Paris, and by reason of its many fine buildings, its splendid avenues and parks, and the organization of its public services, it lays a very strong claim to the title "Paris of South America."

An interesting point connected with the history of Buenos Aires was the fact that the franchise granted for the first transportation line required the exclusive use of horses.

The reason given by the authorities for this stipulation was that it was necessary to develop the national industry of the country, which at that time depended almost entirely upon horse breeding. The tramway was extended by degrees under the old concession for a distance of upward of 100 miles into the country, and there can be no doubt that it holds the record for long distance horse railway, as well as the first tramway to run a sleeping car over its lines. At a later date the authorities recognized that, for the purpose of giving an efficient service, it was necessary to grant a permission to use mechanical traction, and steam locomotives were employed.

The development of the transportation business in the hands of its organizer, Federico Lacrose, became, at his death, still more important in those of his active and energetic sons. Their first step was to enter into a contract, in the year 1905, with J. G. White & Company, of London, for the reconstruction and electrical equipment of the old city lines, which were double track. The work was commenced in March, 1906, and before the end of that year the new power house, with a 2250-kw equipment was in running order—an achievement which, considering the labor troubles and the port congestion, may well be considered a record for rapid construction. Part of the lines were opened formally to public traffic on March 10, 1907. The original lines consisted of 25 miles of track, owned by the company, and 6.21 miles held jointly with other companies and on lease. J. G. White & Company are now engaged in extending these lines an additional 25 miles, and for the purpose of serving these new lines another 750-kw generating set is being added to the station.

POWER STATION.

The power house is of brick, with an exterior plastering usual to the country. The buildings comprise an engine room 190 ft. x 50 ft.; a boiler room, 130 ft. x 30 ft., and a coal storage of the same size. The brick chimney is 150 ft. in height.

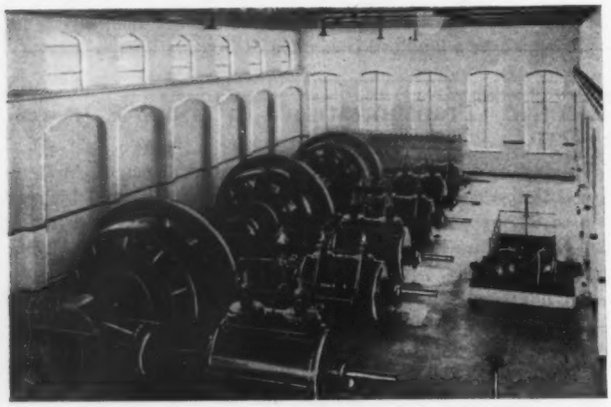
The engine room contains three 1100-hp horizontal cross-compound engines built by Carels Frères, Belgium, after the Sulzer patent; these coupled to General Electric generators. The consumption of the engines averages 22 lbs. of steam per kw-hour, with a load-factor of approximately 40 per cent. Each engine has its own condenser. The air pumps are of the Edwards type, independently driven by steam engines supplied by Allen & Company. Worthington motor-driven centrifugal pumps are used for circulating the water, each being capable of dealing with 1000 gals. per minute. The switchboard was supplied by the British Westinghouse Company.

The boiler room contains five marine type boilers, built by

Babcock & Wilcox, fitted with superheaters, having a heating surface of 630 sq. ft. Each boiler is capable of evaporating 12,000 lbs. of water per hour, the grate area and heating surface being 49 sq. ft. and 2480 sq. ft., respectively. The three feed pumps installed are of the Worthington duplex type. A Wheeler feed-water heater and two cooling towers are used.

The feeders were supplied by Callender's Cable & Construction Company, and are paper-insulated, lead-covered, and are drawn into Sykes' stoneware conduits.

The rolling stock for city purposes will consist of 140 cars of the semi-convertible type, supplied by the J. G. Brill Company, and with a seating accommodation for 32 persons. Each



VIEW OF INTERIOR OF BUENOS AIRES POWER HOUSE.

car is equipped with two 40-hp motors, supplied by the British Westinghouse Company. In addition to the city cars, there will be at first ten interurban cars, which will seat 44 people, and will be fitted with four 50-hp motors.

Electric locomotives will also be used for hauling freight trains. They are being supplied by Dick, Kerr & Company, and each will be equipped with four 50-hp motors.

Mr. C. E. d'Ornellas acted as superintendent in charge of the above work for Messrs. J. G. White & Company, Limited. This company is also engaged upon engineering and construction work connected with the electrical equipment of about 7 miles of double-track for high-speed service from San Martin to Chacarita, for the Ferro Carril Central de Buenos Aires.

Specific Heat of Superheated Steam.

A paper by Prof. C. C. Thomas, read before the American Society of Mechanical Engineers at its recent New York meeting, presented in graphical form the results of an extensive series of experiments relating to the specific heat of superheated steam. In superheating the steam and measuring the energy thus imparted to the steam, use was made of electrical heaters and indicating instruments.

The method employed was as follows: All conditions having been arranged so that they could be controlled, thus providing for practically absolute steadiness of steam pressure, voltage and steam supply, steam was started through a calorimeter and the whole system was allowed to run for several hours before taking readings. When finally steady conditions had been obtained, steam of a certain quality was entering the calorimeter. Electrical energy was introduced sufficient to dry this steam as indicated by the thermo-junction in the calorimeter. Any change in quality was at once indicated by temperature chance. Standard conditions having been obtained—that is, a given quantity of steam passing through the calorimeter per unit of time and receiving just enough electrical energy to dry it and thus bring it up to the "standard" or dry steam condition; then enough more electrical energy was added to raise the temperature of the steam through a given range, either 20, 40, 60, 80, 100 or 150 deg. C. corresponding to 36, 72, 108, 144, 180 and 270 deg. F. respectively. The energy required to produce this rise of temperature having been noted, the initial standard (dry and saturated) conditions were gone back to by dropping out the energy introduced to give the range of temperature. This formed a check on the constancy of the standard condition. From these data specific heats including radiation from the instrument were calculated for the various pressures and temperature ranges employed.

Prof. Thomas found that the specific heat of superheated steam varies with both the pressure and the temperature. It increases when the pressure of the steam increases and diminishes with an increase in the temperature. The specific heat increases and decreases more rapidly when near the saturation point, with increase of pressure and temperature, respectively, than is the case in conditions more remote from the saturation point. These conclusions apply over the whole range covered in the investigation, which included pressures from 7 lbs. absolute to 500 lbs. absolute per square inch and up to 270 deg. F. superheat, for all pressures employed.

At 15 lbs. per square inch absolute and 120 deg. F. superheat, the specific heat is .5; it increases to .6 with the same degree of superheat and a pressure of 600 lbs. per square inch is absolute. At 20 deg. superheat the specific heat is .57 at 15 lbs. pressure, and it is .68 at 600 lbs.

Electrical Development in British Columbia.

The British Columbia Electric Railway Company of Vancouver is making vigorous efforts to get in operation by Christmas a 10,000-hp plant at Lake Buntzen to meet the demands for electrical energy around Christmas time. The complete cost of the single unit being installed, including hydraulic plant, generator, transformers, etc., represents an approximate expenditure of $300,000. Immediately upon its completion the company will make arrangements for the installation of another unit of the same rating, and a third unit will be placed in position later. The business of the company has grown by leaps and bounds during the last few years, and the management consider it necessary to plan far in advance for the meeting of the demands. Hence the announcement of the expenditure of over half a million dollars immediately upon the completion of the present work. The extensive program is also entered upon at once owing to the unavoidable delays which are incident in the delivery of machinery of all kinds nowadays. An illustration of this fact is shown in the installation of the present unit. Orders for its delivery on the ground were given with the last of October as the latest date, but it was nearly a month later before the equipment was at hand. As a result the company was compelled to make use of the old steam plant at the Westminster Avenue station. It is to guard against occurrences of this kind that the larger program of extensions is being immediately taken up. The power now generated at Lake Buntzen comes from four units of 3000 horse-power each. With the installation of the 10,000-hp unit, on which work is now proceeding, 22,000 horse-power will be available. The addition of two more 10,000-hp units will make a total of 42,000 horse-power at Lake Buntzen, which is estimated to be the limit of the water power at that point. The company will by that time have probably secured an additional source of energy, its management now being in possession of the facts concerning every available hydraulic power which has been investigated within a radius of 100 miles of the city.

Rumor has it that its officials already have an option of the Lillooet power scheme, but confirmation of this report cannot be obtained. The final decision as to additional power will be based on the cheapness of the development in connection with nearness to the cities where the company operates. The work now planned in connection with the Chilliwack tram scheme will give the company an established pole line along the south of the Fraser, which can be used in bringing energy from the water powers north of the river to New Westminster and Vancouver.

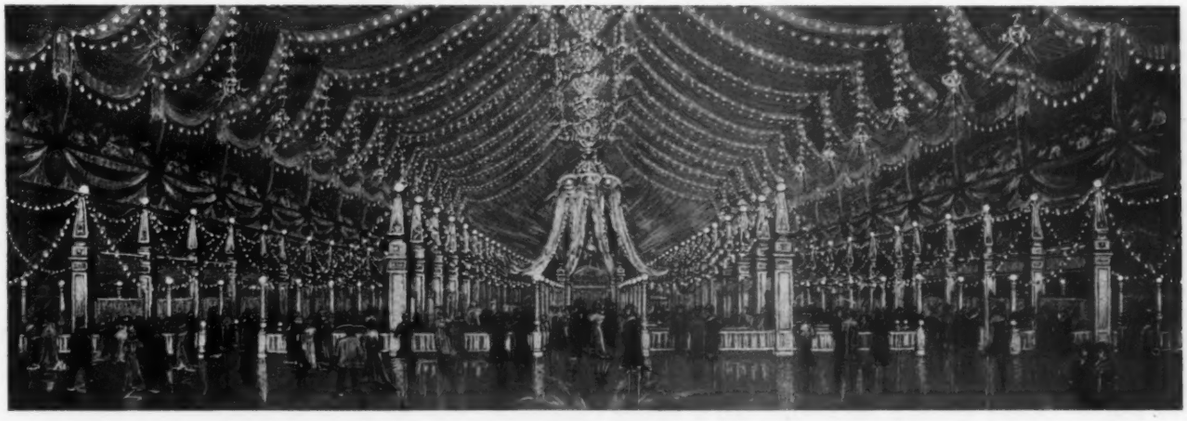
The work of developing the water power at Lake Buntzen for the 10,000-hp unit involved the extension of the power house 40 ft., the work being done through solid rock. The

addition of each of the other units planned will mean additions of equal extent. The extension of the piping for the conveyance of water necessitated the driving of a 232-ft. tunnel, 9 ft. x 12 ft. in dimensions, through solid granite. The transformer house is constructed of concrete.

The work of installing the new plant has been greatly facilitated by the equipment supplied by the company. A track has been laid from the wharf and the loaded cars are taken direct to the site, where a traveling crane carries the various parts to their designated location in the buildings. The British Columbia Electric Railway Company is now contemplating the placing of a larger steamer on the run from the city to the plant owing to the constant demands for communication between the points and the increasingly heavy character of the freight and supplies to be delivered at the power station.

Illumination of the Chicago Electrical Show.

Note was made recently in these columns of the fact that at a meeting in November of the stockholders of the Electrical Trades Exposition, which will conduct the Chicago Electrical show in January, a large picture was exhibited showing the design of the decorative lighting of the Coliseum, which is to be the distinctive feature of the Chicago electrical show this year. This design, shown in the accompanying illustration, has been worked out by D. H. Burnham & Company, the noted Chicago architects. The general scheme comprises a row of mammoth decorative chandeliers the length of the center line of the building and festoons of lamps hung from the arches. The booths will be of uniform design, this design being also made by the architects. The erection of booths and supply of furniture is in the hands of the exposition company, so that the exhibitor has only to move in his exhibit, thus saving a lot of trouble and annoyance to the exhibitor and producing a much



GENERAL VIEW OF CHICAGO ELECTRICAL SHOW.

better general effect. As a spectacular display, the coming show will, it is asserted, be the finest thing of the kind ever attempted in the Coliseum. The dates of the show are Jan. 13 to 25, 1908. Mr. Homer E. Niesz, Monadnock Block, Chicago, is managing director, who reports a very large number of applications for space.

Inverted Synchronous Converters.

The use of a synchronous converter as a combined direct-current motor and inverted rotary converter is disclosed in a patent issued Dec. 3, to Mr. Leonard Wilson. The arrangement employed is indicated in Fig. 1, where the equipment is used to convert direct current at constant voltage into alternating current at variable voltage. Instead of using a direct-current motor for driving an alternating-current generator, the inventor employs an inverted rotary converter and an alternating-current generator mechanically coupled to the converter and electrically connected in series with the alternating-current side of the converter. It is claimed that the machine is cheaper to construct than a motor-generator.

Fig. 2 shows an arrangement of two rotary converters used as substitutes for the motor and generator heretofore em-

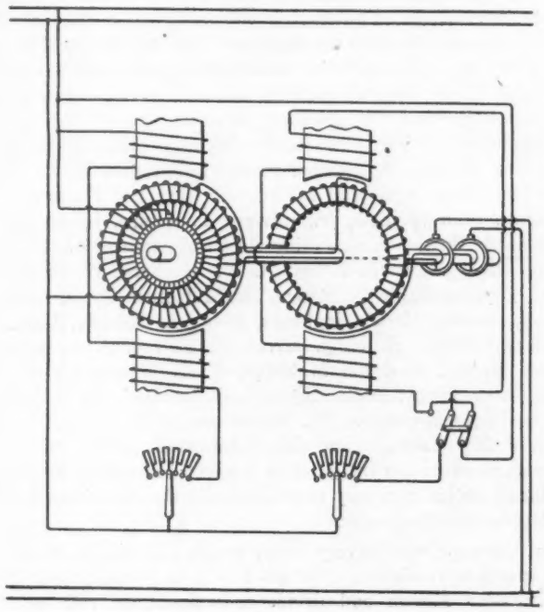


FIG. 1.—WILSON CONVERTER.

ployed in a synchronous frequency converter, as patented by Mr. J. E. Noeggerath on December 3. It is stated that this arrangement is cheaper to construct than the ordinary motor-generator set, both because the rotary converters are self-exciting, and therefore require no separate exciter, and because less armature and field circuit copper is required. Moreover, the direct-current delivered by one converter to the other

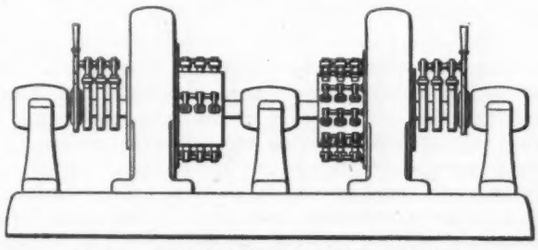


FIG. 2.—NOEGGERATH FREQUENCY CHANGER.

may be employed, by inserting field coils in the direct-current connections between the two machines, so as automatically to compound the frequency changer to cause it to operate at unity power-factor for varying loads, or to increase the voltage delivered as the load increases.

Carnegie Banquet of the Engineers' Club.

The new building of the Engineers' Club on West Fortieth Street, New York was opened for use last April, and is now finished in every part. The first banquet was given on Dec. 9, when Mr. Carnegie, who gave the building to his fellow members was the guest of honor, the occasion celebrating also his seventieth birthday. Two hundred and fifty members were present, a most representative and distinguished gathering from every branch of engineering. The electricals were very much in evidence, including Thomas A. Edison, Frank J. Sprague, H. G. Stott, president of the American Institute of Electrical Engineers; C. F. Scott, John W. Leib, Jr., Edward D. Adams, Joseph Barré, Putnam A. Bates, the consulting electrical engineer of the club; E. W. Rice, Jr.; B. E. Sunny, A. W. Burchard, W. S. Doran, R. C. Clowry, Philip T. Dodge, David Homer Bates, Maurice Coster, Herman H. Westinghouse, Henry L. Doherty, James H. McGraw, Albion E. Lang, Byron E. Eldred, J. R. Ellicott, Frank Hedley, Emerson McMillin, T. C. Martin, Calvin W. Rice, H. L. Shippy, Ernest Stutz, E. G. Bernard, W. H. Whiteside and several others. Mr. Edison sat at the speakers' table between Mr. Carnegie and Mr. John Fritz, who, during the evening, presented to the guest of honor a beautifully engrossed certificate of his honorary membership in the American Society of Mechanical Engineers.

Mr. Carnegie was in very happy mood, and made one of the best speeches of his life after his health had been proposed by Toastmaster Martin and drunk enthusiastically with all the musical honors. He said: "This is the age of the engineer. Never before in the history of the world has he been so important. Perhaps some of you have read Kipling's latest production, 'The Sons of Mary and Martha.' Upon the latter there has been thrown the work and cares of the world; theirs to transform conditious, to invent, plan and execute and bring to man all the improvements that have delighted and astonished us in this generation and the last, beyond all others that have preceded. We telegraph without wires, and neither under nor upon the ocean, but through the air, annihilating space. We fly with the speed of birds of the air by a spark of gasoline. We speak to each other through the telephone of Bell, and listen to the finest music in our homes from the imprisoned voices of the greatest singers in the phonograph of Edison. Mysterious powers hover round us subject to our call. All this would have seemed miraculous to our grandfathers.

"The engineers are the true sons of the more useful sister and are indispensable. They have played a great part in this transformation. The sons of Mary may be all well enough in their place, although I confess myself at a loss just exactly to find a place for them that redounds much to their credit in this everyday world. We can see little use for them and cannot help the thought arising at the moment that it may be very much with them as Josh Billings said about mosquitoes: doubtless the Lord made all things well and there was some reason for making mosquitoes, but he wished it had been so arranged in their case that they would only bite those that could see it. One feels something of the same thing when he views the gay, sporting, frivolous lives of the sons of Mary."

He concluded as follows: "I trust that this club is to see many such happy reunions as we have to-night. There are very few things in life more desirable, more beneficial, than a good laugh. Take life brightly. Of all things be optimistic. Do not lie awake at night troubling yourself about problems that have a way of solving themselves, and above all things don't worry about the republic—she is all right. She is the latest and best of the great nations, built upon the best specifications, up to date, of the best material, the finest grade of vanadium steel, warranted to stand all weathers and to give a good account of herself under any conditions that ever can prevail. Gentlemen, may the influence of this club upon you be such that in after life *Hamlet's* saying can be yours: 'I think myself in nothing else so happy as in a soul remembering my dear friends.'"

Mark Twain, arrayed in spotless white, who came to New York 54 years ago to see the first World's Fair on the very spot where the new club now stands was particularly humorous at Mr. Carnegie's expense, attacking him vigorously with jibe and sarcasm on account of his "simplified spelling"—as an offset to the eulogies and compliments from all the other speakers. Mr. John Foord, member of the club and president of the Burns Society, was very felicitous and graceful in responding to the sentiment "The Scot in America." Mr. W. H. Fletcher, past president of the club, and chairman of the building committee, made an eloquent eulogy of those who had devoted their services to the club while they lived, and summed up the results of the committee's four years of work. The total cost of the club including land, building, plant and equipment was stated to be $867,000, and the clear equity of the body to-day above all indebtedness was over $565,000. During the evening the names of Mr. C. M. Wales, chairman of the house committee; Mr. G. E. Weed, treasurer, and of Admiral Melville, who was present as a member, elicited great applause.

CURRENT NEWS AND NOTES.

ILLNESS OF KELVIN.—We regret to state that special cable advices from London of Dec. 10 say: "Lord Kelvin, the noted scientist, has been confined to his bed for two weeks with a chill. His condition has become serious. He is 83 years old."

AT MAHOMET'S TOMB.—An imperial iradé has been issued by the Sultan of Turkey ordering the establishment of electric lighting in the sanctuary of the Prophet at Medina. The contract for supplying the plant has been awarded to an English firm.

ILLUMINATING ENGINEERING SOCIETY.—The December meeting of the Philadelphia section of the Illuminating Engineering Society will be held on Friday evening, Dec. 20, at 8 o'clock, in the assembly room of the Philadelphia Electric Company, Tenth and Chestnut Streets. Professor H. Clyde Snook will deliver a lecture on "The Light Spectrum," illustrated with lantern slides.

ELECTROCHEMICAL SOCIETY.—The next meeting of the New York section will be held on Tuesday, Dec. 17, at 8:15 p. m. at the Chemists' Club, 108 West Fifty-fifth Street, New York. There will be informal talks by the following speakers. The subjects will be open for discussion by members of the section: Mr. Lawrence Addicks, superintendent U. S. Metals Refining Company, Chrome, N. J., "The Refining of Copper;" Mr. Harold Martin, formerly of the Chloride Accumulator Company, "The Modern Developments in the Storage Battery." Members of the section are invited to introduce as visitors any of their friends who are interested in the above subjects.

TWO MILLION MORE.—Mr. Andrew Carnegie this week has added the sum of $2,000,000 to the $10,000,000 endowment fund of the Carnegie Institution for scientific research at Washington. Announcement of the fact was made at a dinner on Dec. 10, of the board of trustees of the institution, to which had been invited a number of scientists and men prominent in public affairs. The dinner followed a business meeting held earlier in the day at the institution's offices. The report of the trustees showed that much important scientific work had been done during the past year, and upon their recommendation $529,940 was allotted for the prosecution of the work of scientific inquiry next year. The trustees also decided to erect a suitable building in Washington for the accommodation of the administrative offices of the institution in place of the present rented quarters.

SUBWAY FOR BERLIN.—The Traffic Commission of the municipality of Berlin has decided to build an underground railroad running northwest and southeast through the heart of the city, from Charlottenburg to Rixdorf. The cost of the new line is estimated at $15,000,000. It is an addition to the subway to run north and south, plans for which are now under preparation. Berlin is also to have five new surface lines to meet the traffic demands of the population.

SEARCHLIGHT SHELLS.—It is stated from Paris that a French naval officer has invented a new shell, which, when it strikes, throws out a luminous white light which lasts for 30 or 45 seconds. The shells are being experimented with at Lorient Bay. They are 2.6 inches in diameter, and are likely to be a valuable asset in warfare since, during a night attack, they can be thrown from a masked battery and perform the service of searchlights without uncovering their source.

FRENCH TELEPHONY.—A special cable dispatch from Paris of Dec. 7, says: "The defective French governmental telephone service has long been a cause of complaint, consequently each provincial department has ordered that courses in telephoning be given to beginners, with money prizes for the best pupils and teachers. In certain cities the teachers give their telephone lessons during office hours. From one town, although the lessons had not yet begun, reports of the excellent results of the instruction were sent to the authorities, who promptly formarded rewards for the fictitious services."

POLICE ALARMS FOR RIO JANIERO.—A special cable dispatch from Berlin, Germany, of December 7, says: One of the great Berlin electric works is giving a private exhibition of an elaborate new police alarm installation it has just completed for the city of Rio de Janiero. It represents a cost of $500,000 and its special feature is a system of 580 patrol boxes to be scattered throughout the city, the keys to which may be purchased by trustworthy citizens, enabling any of them to turn in a police alarm just as fire alarms are now turned in by the public., In order to identify the person who turns in the call, his numbered key can be extracted only by the police.

LONDON UNDERGROUND.—A cable despatch from London, of Nov. 30, says: "Another half mile is added to-day to London's system of electric transit. This is a spur from the Strand to Holborn, where connection is made for Finsbury Park on the north and Hammersmith or Brompton on the west. It is the third crosstown line in operation between the Strand and the northern suburbs and is likely to command a large traffic as a branch of the Great Northern, Piccadilly & Brompton system of tubes. Investors are paying heavily for Mr. Yerkes's miscalculations, but traffic on the underground lines is slowly increasing. Owing to the quickening of trains and the improvement of electric services, motor omnibuses are dropping out and the volume of surface transit is decreasing."

THE LAKE NEMI GALLEYS.—Steps are being taken to recover the galleys that lie at the bottom of Lake Nemi, in the Alban Hills. The Italian Minister of Public Instruction has before him the report of Prof. Giuria, which by many is considered the most practical plan of all. It is certainly the cheapest to carry out. Prof. Giuria would make use of the old Roman aqueduct, which is still in fair working order, and employ two powerful pumps to carry the water in double pipes across the Valley of Ariccia, where it will drive an electric plant which, in turn, is to supply the energy for the pumps. When the water has been sufficiently lowered to permit dry working, Prof. Giuria purposes to raise the galleys by an inclined plane from the bed where they lie to the shore. By building a skeleton cradle in iron with double runners around each barge, he believes he might bring them to land without damage to the structures. It is expected that the latter scheme will be adopted and that the work will begin next summer. An encouraging piece of intelligence has just been added by Signor Rossi of the Italian Marine electrical staff, who, in diver's dress, spent an hour in the Caligula galley the other day. He reports that some of the apartments and even their furnishings and furniture are still intact, and, curious as it may seem, that, while the stonework has in many cases been eaten away, the woodwork still remains, especially the hulls, which were originally covered by cloth attached by a coating of pitch, above which Rossi discovered many folds of thin sheet lead, doubled over to a great thickness and fastened with copper nails.

ELECTRICITY FOR SAVAGES.—Advices from Japan state that the extermination of savage, murderous head hunters by electricity is the latest novelty introduced by the Japanese in Formosa. These head hunters number about one hundred thousand and infest the entire eastern coast of the island. All efforts to civilize them have failed. They recently inveigled a party of 300 Chinese and Japanese into an ambush, on the pretense of showing some treasure, and killed all but three. Large bodies of troops were sent out, and now when a company of head hunters is located the place is surrounded by a wire fence. The wires are charged with electricity. The soldiers begin to shoot; the savages stampede, and then the deadly wires get those that the bullets miss. Presumably the Japanese carry a portable dynamo plant with them. Otherwise the story is apocryphal.

ELECTRIC CLUB OF CLEVELAND.—On the evening of Wednesday, Dec. 4, the Cleveland Electric Club held its regular meeting in the club rooms. The technical part of the evening was devoted to a paper by Mr. Chas. F. Saenger, engineer of equipment, the United States Telephone Company, Cleveland, his subject being "Notes on Modern Long Distance Telephone Practice." The paper was delivered from the standpoint of a practical man, and was interesting alike to the technical man and the layman. The theory of the telephone itself was first presented, and Mr. Saenger gradually worked up to the modern long-distance telephone. Practically all the forms of telephones in use to-day were discussed and their good and bad points brought out. The discussion following the reading of the paper was quite lively, and brought forth a great deal of valuable information. It branched off from the telephone itself to the composite systems of sending telegraph and telephone messages over the same wires, the "telharmonium" and other kindred devices.

WHEN A QUEEN TELEPHONES.—A special wireless dispatch from Paris reports that Queen Amelie of Portugal quite innocently interrupted the progress of business of two of the world's greatest financial centers one day last week by a friendly chat with members of the English royal family over the long distance telephone. As is commonly the case between London and Paris, the telephone on that day was working badly and only one wire could be depended on by busy bankers who transact much of their daily business with London by telephone, owing to the notorious slowness of the government telegraph service, which caused 60 to 80 persons to be on the waiting list. Then the central office received a call from the Hotel Bristol that somebady wanted, Buckingham, Palace, London. Central replied: "All right; your number is 75 on the list." The voice on the other end of the wire gave a wail of despair: "But it's for Queen Amelie. Her Majesty wants the royal residence, Buckingham Palace." Central began to understand. There was a hurried consultation of the chief supervisors and the call went through on record time, and on the one good wire the Queen chatted leisurely with her royal friends in London for a good half hour, unconscious of the turmoil she was creating in the financial world. English bankers who were discussing the American crisis and gold engagements with their Paris correspondents were frantic, not knowing what might happen during the interruption.

CANDLES GALORE.—According to the calculations of one of the best-informed manufacturers of candles in Chicago, over 130,000,000 lbs. of tallow are used every year in the manufacture of candles in the United States. And yet some of the central-station companies have stopped their canvass for new business!

ABRASIVE MATERIALS.—Natural abrasives valued at $1,473,393 and artificial abrasives valued at $777,081 were produced in the United States during the calendar year 1906, and imports to the value of $909,964 brought the total value of abrasive materials consumed in the year up to $3,160,438. These figures are reported by Douglas B. Sterrett, of the United States Geological Survey, in an advance chapter from "Mineral Resources of the United States, Calendar Year 1906." The values of different abrasives for 1905 and 1906 are shown in the following table:

Kind of abrasive.	1905.	1906.
Carborundum	$5,596,000	$6,225,300
Crushed steel	612,000	837,000
Alundum (artificial corundum)	3,612,000	4,712,000

METAL TRANSMUTATION.—A recent cable dispatch from London says: "Prof. Herbert McCoy of the University of Chicago in a letter to *Nature* says that it is possible that the making of copper by radium emanations, as recently announced by Sir William Ramsay, is not confined to the solution, for the transmuting may also occur in a solid state. If so, it should be possible with those minerals which contain both radium and copper-lithium also. Prof. McCoy then gives an account of his investigation with uranium and radium minerals, showing that they contain both copper and lithium, and adds that this does not necessarily indicate a change of copper into lithium, since the presence of lithium may be fortuitous. Assuming the accuracy of Sir William's observations, the presence of lithium in uranium and radium copper minerals is precisely what one should expect."

METER EXAMINATIONS.—The New York Public Service Commission in the Second District announces that arrangements have been perfected for testing the correctness of electric meters. The charge for testing will be refunded to the applicant in case the meter proves to register more than 4 per cent too fast. All applications must be addressed to the Light & Power Department of the Public Service Commission, Second District, Albany, inclosing $1 if the meter is rated at 5 amperes or under; $1.50 if over 5 amperes and not exceeding 10; $2 if over 10 and not exceeding 15; $2.50 if over 15 and not exceeding 25; $3 if over 25 and not exceeding 50, and 50 cents for every additional 10 or fraction thereof. The state has been divided into four inspection districts, with John P. Geberlein, of Brooklyn; Leo E. Northshield, of New York; Fred W. Schiller, of Utica, and Archie C. Brown, of Dannemora, as inspectors, at an annual salary of $1,200 each.

A RED LINE WIRELESS.—Despatches from Vancouver, B. C., state that a project for establishing a system of wireless telegraphy between Vancouver and New Zealand and Australia is being considered by the British Government. It is the outgrowth of a proposition to connect the various British islands in the South Pacific. Mr. F. J. Cross, an American electrical engineer, says the project is quite feasible and that he was commissioned last July to report on it. He returned recently on the steamer *Aorangi* from the Fiji Islands. His report is now en route to Winston Churchill, the colonial secretary in the Imperial Government. The only station on foreign soil may be located at Honolulu. The entire cost is estimated at less than $500,000. Mr. Cross says: "In the alternative scheme stations will be established in the Samoan group, now occupied by three powers, and the Marquesas Islands, owned by France. The British islands to be hooked up include Fanning Island, Tonga group, the Fiji group, and Ellice Island. From Fiji to New Zealand the distance is about 1540 miles, and from Fiji to Brisbane the distance is less."

WISCONSIN PUBLIC UTILITIES LAW.—A law recently passed in Wisconsin, putting all public utility companies under the supervision of a state commission and virtually taking out of the hands of the city councils the power of regulating or giving new franchises to street railway and electric light companies, has now been in force some months with good results. The Common Council of Milwaukee seems inclined to dispute the authority of the law, however, and passed a franchise recently granting the Continental Realty Company of that city authority to tunnel in several streets for the supply of steam heat. The Central Heating Company, controlled by Mr. John I. Beggs, is already in possession of the streets for heating purposes, and under the Wisconsin law, has a monopoly of the business in Milwaukee, unless a competing company should apply to the railroad commission for permission to put in a competing system on the ground that the existing company is not properly serving the city. It seems likely that the practical effect of the new Wisconsin law as regards its monopoly clauses will, therefore, soon be tested in view of the action of the City Council.

FRENCH NAVAL WIRELESS.—La République, a cruiser of the French Navy, which has just arrived at Tangier, reports some remarkable results of wireless telegraphy to the Minister of Marine. This report was sent in a wireless message from the cruiser to the Eiffel Tower, in Paris. On leaving Toulon, the *République* first went to Ajaccio, choosing this port as exceptionally difficult from being almost landlocked and surrounded by high mountains. Nevertheless, she communicated easily and regularly with the *Jules Ferry,* in Toulon Harbor. Putting out to sea, and gradually increasing her distance, she kept in uninterrupted telegraphic touch with the *Ferry,* and exchanged messages across 750 kilometers or about 466 miles, or over twice the distance covered up to now. From the Gulf of Juan she also communicated with the Eiffel Tower over a land distance of 800 kilometers (about 497 miles). Being skeptical of having attained this result, the operators asked the Eiffel Tower for confirmation by wire, which they received. Hitherto, the French vessels in Moorish waters have been able to take messages from the Eiffel Tower, but not to send them back. However, it is finally proved that it is feasible to communicate over 500 miles of country and 1000 miles of water. This is due, it is asserted, to the new instruments invented by the French naval officers, MM. Ferrier, Dissot and Géance, which permit of perfect immunity from interception.

THE SOCIALISTIC MILLENNIUM has been definitely located at Brest, France. For three years Brest has been completely under the control of Socialists. It has 71,000 inhabitants. In 1904 less than 5000 were in receipt of poor relief. Last year this number reached 23,584, or one-third of the total population. Investigation has proved that the persons who received relief were not all in a state of poverty, but were the recipients of corrupt indulgences on the part of the Socialist Administration. In 1904 the council organized a municipal theater. After two years of Socialist plays the audiences so fell off that last year the theater was run at a loss of $8,000. In three years the building trade fell off 90 per cent, the local customs diminished 60 per cent and the council spent three-quarters of the $90,000 surplus left by their predecessors for purposes that have not yet been elucidated. Many of the schemes put forward seemed laudable enough, but ultimately turned out to be vehicles of wholesale extravagance. It was decided to organize the distribution of pure milk in the working class quarters. The total expenditure was $7,000, of which half was paid in wages and rent. Each litre (1¾ pints) of milk was sold among the working class for three cents, but it cost the municipality in distribution seven cents. At the last election the Socialists, having reduced the finances of the town to a state of absolute bankruptcy, surrendered their power, and the new administration has been obliged to appeal to local capitalists to prevent complete disaster. It is stated that investigations of the recent régime and criminal prosecutions will follow.

Combined Gas Works and Electric Generating Station.

A UNIQUE electrical installation, stated to be the only instance in England of an electric generating station running in connection with gas works, was formally opened at Ascot on Oct. 22. The Ascot District Gas Company, in answer to a demand for electricity within the area covered by its mains, obtained permission to change its title to the Ascot District Gas & Electricity Company, to erect a generating station, and to supply electrical energy in the parishes of Sunningdale, Sunninghill, Easthempstead, Warfield, Binfield, Winkfield, Waltham, St. Lawrence, Bisley, Cobham, Windlesham and Bagshot.

The electric generating station has been erected in close proximity to the gas works; in fact existing buildings formerly used in the manufacture of gas have been converted for the accommodation of the storage batteries and the gas engines. It is interesting also to note that electric motors are now being installed in the gas works for a number of purposes.

The electric generating equipment consists of two Johnston & Phillips direct-current 110-volt dynamos driven by Hornby-Stockport 90-hp horizontal gas engines operating at 210 r. p. m. The engines have electric ignition, and are started by means of compressed air provided by a motor-driven air compressor.

Outside the engine room there is mounted on iron columns and girders a cast-iron tank 18 ft. x 12 ft. x 6 ft. deep, which serves as a reservoir for the water for the gas plant and also for the water circulation of the engines. Each engine drives a small centrifugal pump for circulating the water. The water for the tank is taken from a well by means of a motor-driven pump; in the event of the well failing, a supply can be obtained from the water company's mains.

Gas for the engines is supplied from a Hornsby suction producer provided with the usual cleaning and scrubbing plant, as seen in Fig. 2. A motor-driven blower is provided for the producer, a hand-operated blower being installed as reserve. Moreover, there being only one producer, a branch from the lighting gas main is run, through a meter, into the engine room, so that either engine can be operated with illuminating gas when desired. The fuel used for the producer is coke, which is obtained from the gas works. Fig. 3 indicates the relatively small space occupied by the producer plant.

The electric generating equipment includes a semi-automatic balancer-booster, consisting of two balancer-motors and two booster dynamos mounted on the same shaft. Each booster is designed for 100 amperes at any e. m. f. up to 90 volts. The field coils of the balancers are cross-connected, and the boosters are arranged with series and shunt field coils, as shown in Fig. 4, so that they automatically regulate the e. m. f. The feeder circuit voltmeters, in addition to being of the "compensated" type to show the e. m. f. at the ends of the feeders, have attachments by means of which electric bells ring when the e. m. f. rises or falls by a predetermined amount from normal. This plan is exceedingly convenient, because it obviates, with the assistance of the automatic booster, the necessity of constant attendance at the switchboard.

The storage battery regulating switches are actuated by means of spindles and handles on the main board, all of the battery connections being in the cell room. In order to prevent the boosters from racing in case the fuses blow, the following arrangement has been adopted. A switch, *S* (Fig. 4), is held

FIG. 2.—VIEW OF GAS PRODUCER PLANT.

FIG. 1.—GAS ENGINE GENERATING STATION, SHOWING BALANCER-BOOSTER.

up by each motor fuse; in case the latter melts a circuit is closed through the coils of a relay, *R*, which operates the automatic switch shown, so that the battery is disconnected from the booster and connected directly to the bus-bars. The storage battery consists of 240 Tudor cells rated at 54 x 10 ampere-hours, or 140 x 3 ampere-hours.

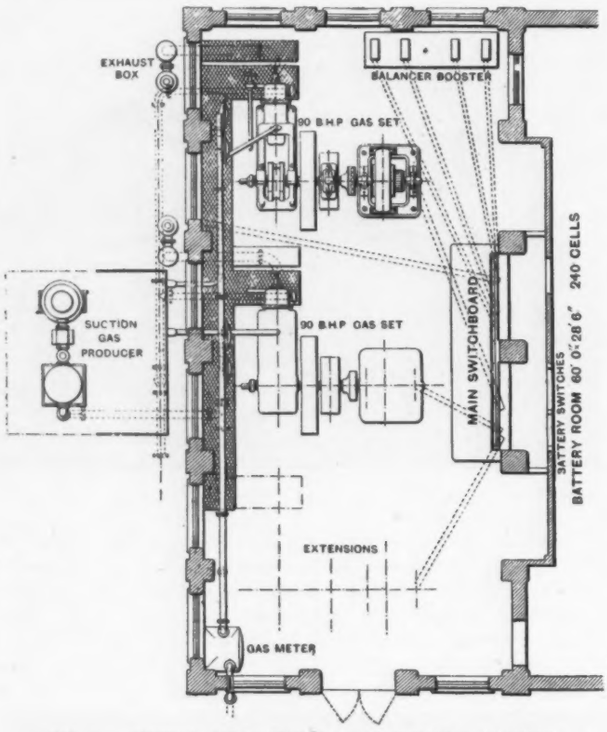


FIG. 3.—GENERAL ARRANGEMENT OF GENERATING STATION.

At the present time about seven miles of three-core, paper-insulated, lead-covered Siemens cables have been laid on the solid system in wooden troughing. Owing to the large area over which energy is distributed to consumers, there has been a considerable outlay for mains. Lead-wiped joints are used throughout the whole system and at all three-way and four-way disconnecting boxes; the grounding of the lead sheathing being continuous throughout. The type of four-way disconnecting box which has been adopted is shown in Fig. 5; it will be noted that fuses can be used if desired. Ampere-hour meters of the Siemens pattern are used on consumers' premises.

It is estimated that about 1.3 lbs. of coke are required per kw-hour of energy generated, and that 72 lbs. of coke, when burned in the producer, are equivalent to 1000 cu. ft. of the gas supplied to the consumers. The price of energy has been fixed at 14 cents per kw-hour for lamps and 8 cents for motors, the e. m. f. being 220 volts on either side of the three-wire system.

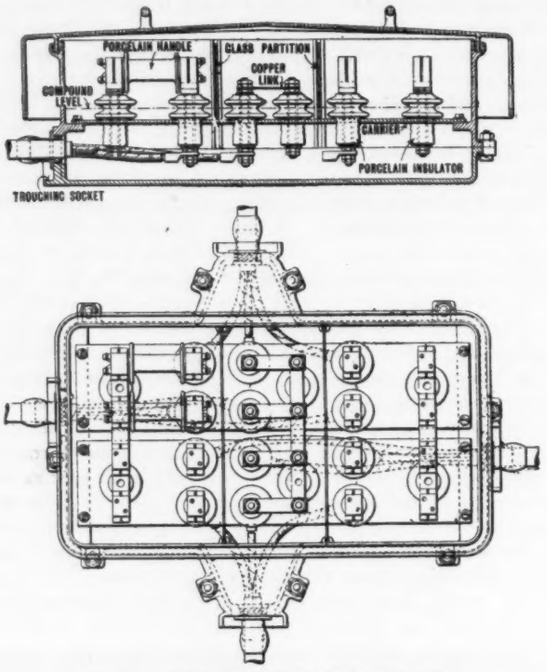


FIG. 5.—FOUR-WAY DISCONNECTING BOX.

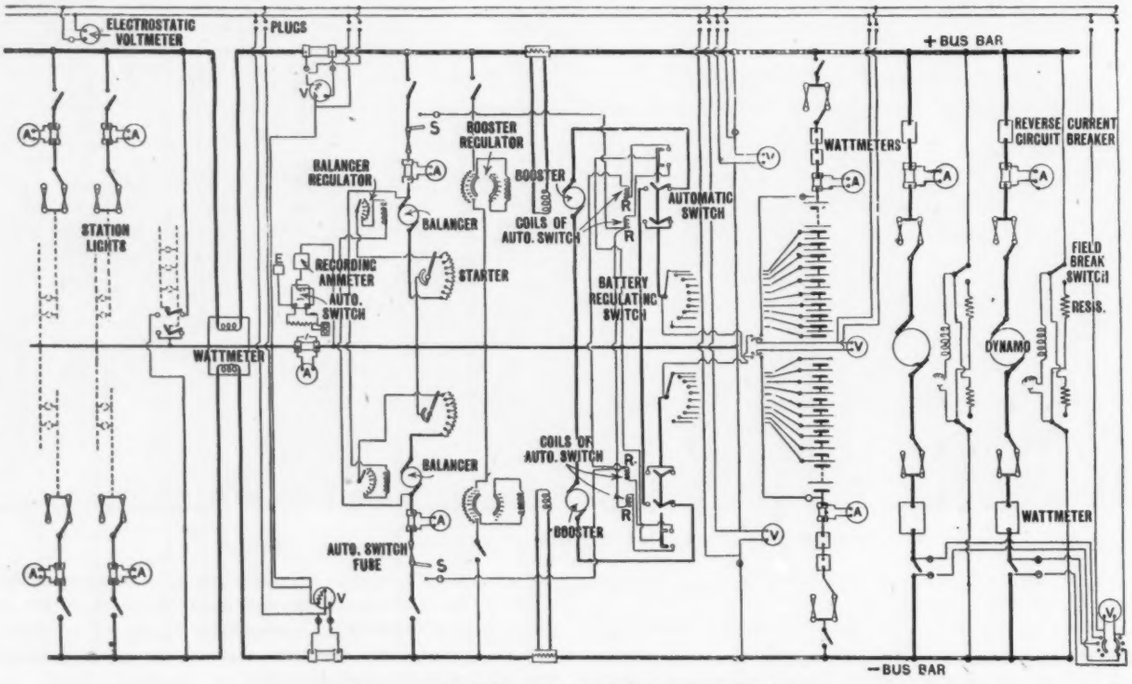


FIG. 4.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

Illuminating gas is sold at $1.18 per 1000 cu. ft., the coke for which costs 24 cents. It is estimated that the coke in the producer for one kw-hour costs .24 cent; the works cost of the kw-hour is 2.84 cents and the total cost 4.78 cents.

A brief item concerning the above combined gas and electricity works was published in our issue for Nov. 16. We are

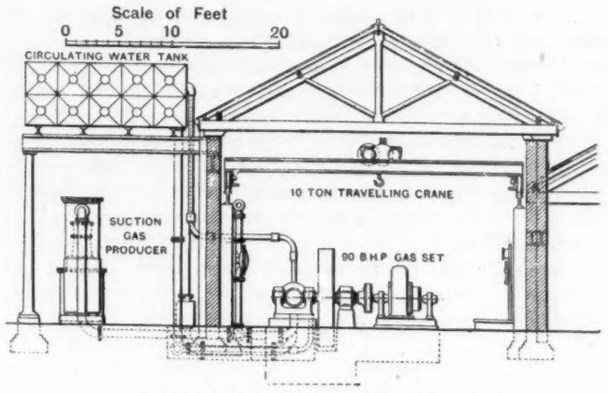


FIG. 6.—CROSS-SEDTION VIEW OF STATION.

indebted to the London *Electrician*, from which this item was obtained, for the illustrations used in the present article.

The Design and Operation of Spark Coils.

BY F. W. SPRINGER.

IN the present state of the art of constructing igniting coils the basis of their design may be described as follows: 1. Methods of compromising and varying the various design factors of different coils and the effects of such variations. 2. The constructive and electrical characteristics of each kind of coil. It is the object of the present article to treat these two divisions in detail.

The factors which affect the operation of spark coils are so interdependently variable that it is somewhat difficult to foretell offhand exactly all the results of changes in the voltage, E, of the source of current; R, the total resistance; L, the total self-induction; t, the length of the time of contact in the contact maker or vibrator; I, the value of the current at the moment of breaking the circuit, and the various electrical and mechanical features of construction.

The energy, J, of the spark must, of course, be determined by experiment, and should be known for a particular engine operating under the desired conditions before attempting to design the spark coil.

It is permissible to assume that the energy, J, of the spark desired is known in discussing the determination of the best values of E, R, t, L and I, and the other electrical and mechanical features for: (1) a touch spark coil, (2) a non-vibrating jump spark, and (3) a vibrating jump spark coil.

The operation of coils, their characteristic current-time curves, etc., need not be discussed here as they have previously been rather fully treated in ELECTRICAL WORLD.

Referring to the two fundamental equations of spark coils, *i. e.*, the logarithmic current-time building up and energy equations, respectively:

$$I = \frac{E}{R}\left(1 - \frac{1}{2.718^{\frac{Rt}{L}}}\right) \qquad (1)$$

$$\text{and } J = \frac{L}{2} I^2 \qquad (2)$$

it is seen from equation (1) that the current, I, at the moment of breaking the primary or battery circuit may be calculated for any desired values of time of contact t, voltage E, self-induction L and resistance R. The amount of magnetic energy in watt-seconds or joules, J, stored may be calculated from equation (2).

Since the energy of the spark is largely determined by the amount of magnetic energy stored in the circuit, one may assume that J, of equation (2) represents the spark energy.

It is seen from equation (1) that the value of the current I at the moment of breaking the circuit in the timer for any given time, t (R and L being constant) varies directly as the voltage E. This is shown in a particular case by the curves A and B, Fig. 1, in which one curve represents results with 8 volts and the other with 12 volts.

From equation (2) it is seen that the energy of the spark varies as the square of the current I, or as E^2. Hence doubling the voltage will increase the energy of the spark to four times its former value—R, t and L remaining constant. See curve J-E, Fig. 3. Further, J varies (equation 2) directly as L, the coefficient of self-induction in henries, so that the value of the desired energy of the spark may be ascertained while using widely different values of L and I. If a value of I is decided upon, L may be determined by solving equation (2). If a certain value of L is used, such values of E, R and t must, of course, be taken as will give the necessary value of I (equation 1).

Therefore one needs merely to decide upon the desired values of L and I and then to compromise upon such values of E, R, t and L as will give the desired energy of the spark, J, and fulfill any other desired conditions. For example, use may be made of the data of the touch-spark coil taken as an illustration throughout this paper, as follows: A coil having a resistance of 9 ohms with the battery and wiring, provided with a 1 in. x 6 in. core of round iron wires and 1320 turns of No. 20 copper wire. Its self-induction is 0.22 henry.

It was found by experiment that each spark occurring in a

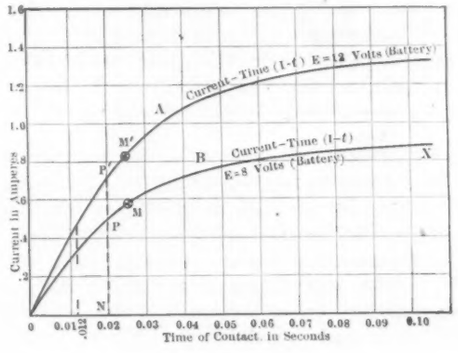


FIG. 1.—BUILDING-UP CURRENT CURVE OF AN INDUCTIVE CIRCUIT.

2-hp White marine engine running at 600 r. p. m., had magnetic energy, J, equal to .025 watt-seconds.

The time of contact, t, at the above speed (see Fig. 2) was 0.02 second, the e. m. f. of 6 dry sells (open circuit) 8 volts. The total resistance being 9 ohms and the self-induction 0.22 henry, from equation (1).

$$I = \frac{8}{9}\left(1 - \frac{1}{2.718^{\frac{9 \times .02}{.22}}}\right)$$

$I = .48$ amperes (Point P curve B, Fig. 1).

From equation (2),

$J = (0.22 \div 2) \times .48^2 = .025$ watt-seconds.

The above methods of calculating the current and the spark energy might be applied to any touch-spark coil under any known conditions, and also to the primary coil of a vibrating, or of a non-vibrating, jump-spark coil.

Equation (1), as illustrated above, may easily be solved by the use of the logarithmic side of the slide rule. There is, however, a much simpler method as follows:

Referring to equation (1) and curve B, Fig. 1, if in the equation the time, t, be made equal to $\frac{L}{R}$ (in this case $\frac{.22}{9} = .0244$

second) (point M) the current I, when $t = \frac{L}{R}$, will be 63 per cent of its full $\frac{E}{R}$ value (.89 amp.) or 63 per cent of that value which the current would attain if allowed to continue to increase for an indefinite length of time.

The time $\frac{L}{R}$ is called the "time constant" of a coil, and is designated by the letter T.

Knowing the self-induction and resistance of a coil, two points are determined, namely, the time required for the current to reach 63 per cent of its full value and the spark to reach (.63²), or 40 per cent of its full value.

Referring again to curve B, Fig. 1, it will be noticed that, between points M and O, the current varies approximately as the time, t, hence for any value of the current for a time less than the "time constant," $T = \frac{L}{R}$, a practically correct value may be obtained as follows:

Suppose it is desired to know the value of the current at 0.012 second for a coil having the data of Fig. 1, curve B (9 ohms, 8 volts, .22 henry). Then, for

$$t = L \div R = .0244; I = .63 \times .89 \text{ amp.} = .56 \text{ ampere}$$

Then $\frac{.012}{.0244} \times .56 = .27$ amp. is the value of the current when the time is .012 second. This approximation will be found to be sufficiently accurate for all practical purposes.

The energy, J, of the spark at this point would be

$$J = \frac{LI^2}{2} = \frac{.22 \times .27^2}{2} = .008 \text{ watt-second,}$$

a spark of small energy.

It has been found by experiment, that under the ordinary working condition of the common four-stroke cycle gasoline engine that a (touch) spark having a magnetic energy of .04 watt-second is sufficient. A more powerful spark, one whose energy is at least 0.1 watt-second, is desirable at starting, when the gas charge is at low compression and low temperature.

Under very favorable conditions it has been found that a spark having energy of .005 watt-second is sufficient to ignite the charge in a 2-hp White engine with practically no diminution in speed. But whether or not the energy of a spark is sufficient depends upon the temperature, compression and richness or leanness of the gas charge, and amount of diluent, such as that of burned gases, and the engine speed. A series of weak sparks may, no doubt, be equal to one strong spark in some cases, such as in starting and at low speeds.

It is desirable in seeking suitable values of E, R, t, L, etc., to know beforehand approximately how different values of the above factors will affect the result. These results may be discussed under three heads, as follows: First, those conditions which more or less involve the engine and other conditions outside of the coil; second, the more or less mathematical characteristics of the coil; third, the electro-mechanical features of construction.

(1) Practice seems to show that the e. m. f. in a touch-spark circuit should be not less than eight volts owing to the unreliability of contact in the engine. It should also not be so large as to hold the arc too long after the contact points are drawn apart in the engine cylinder.

(2) Owing to armature reaction in a dynamo and to polarization in batteries, the equivalent working closed-circuit voltage in either case is liable to be considerably less than that measured by means of a voltmeter while the circuit is open.

(3) In case a dynamo of the direct-current magneto type is to be used, a rather large voltage is desirable owing to the brush resistance. In case of batteries it is generally thought best to keep the number of cells as small as possible. This is especially true in the case of non-vibrating and vibrating jump-spark coils where the contacts can be readily kept in good condition.

(4) If both a battery and a dynamo are to be used with the same coil (the battery for starting and as an alternative for the dynamo), the above conditions must be compromised. There is no objection, however, except as to cost and weight, to the use of separate coils for the dynamo and the battery.

(5) If the time of contact, t, is not a constant one but varies inversely as the engine speed, as is usually the case, thereby permitting a very long time of contact while running slowly in starting, the resistance in the circuit should be large enough to prevent short-circuiting and polarizing the battery. Further, it is desirable that the resistance be large enough so that any variation of the contact resistance of the points in the engine cylinder may not affect the total resistance by a large per cent.

(6) The time of contact, t, should occur over such a portion of one fly-wheel revolution that any slight wear, as of the timer, or "throwing off" as at high speed, may not materially alter the time of contact. The time of contact is usually between 15 and 25 per cent of that of one revolution. Fig. 2 shows the variation in the time of contact, t, for different engine speeds and different arcs of contact as expressed in per cent of one fly-wheel revolution.

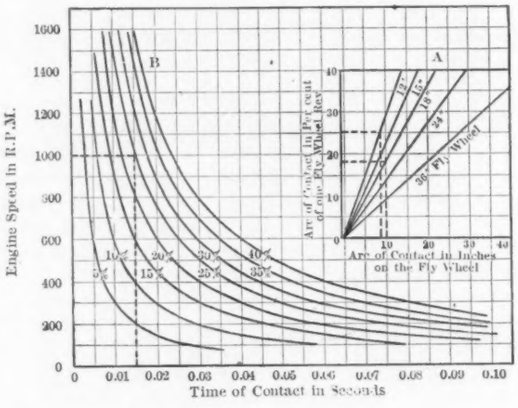


FIG. 2.—TIME OF CONTACT AT DIFFERENT ENGINE SPEEDS AND ARCS OF CONTACT.

(7) A small value of L would necessitate a large current, I, to give the desired spark with the resulting drain on the battery, and with large I^2R losses. (Equation 2.)

(8) While the efficiency of an igniting system is a matter of minor importance when a dynamo is used as the source of energy, it is of vital importance if batteries are to be used exclusively.

(9) The weight, cost of construction, shape, etc., of coils may also become important in special cases.

With the above conditions in mind it may prove instructive to follow the results of varying E, R, t and L upon the values of the current, I, and of the magnetic spark energy, J. It will be assumed that the coil used is the one described above.

The effects of varying the above factors will be taken up in the order given. As a rule only one factor will be varied at a time, in order to show the resulting variation in the current value, I, and the energy of the spark, J, at the moment of opening the circuit of the source of energy.

As already stated I varies directly as E, and J varies as E^2. These are shown respectively by curves A and B of Fig. 1, and J-E of Fig. 3.

In order to ascertain what value of E will give the maximum efficiency (that is, will make the ratio of the energy of the spark, J, to the chemical expenditure a maximum) let A be the area OPN under curve B of Fig. 1. This area represents the chemical expenditure per cell in coulombs, or ampere-seconds, when the spark-gap opens at point P, and may be determined by

a planimeter or from the general equation for the area of a logarithmic curve, which is

$$A = \frac{E}{R}\left(t + T\left(\frac{1}{e^{\frac{t}{T}}} - 1\right)\right) \qquad (3)$$

in which T $(= L \div R)$ is the time constant, and E $(= Ne)$ is the number of cells times the voltage per cell. Equation (2) is the general expression for the energy of the spark, J, at point, P. It thus remains to find that value of Ne which will render $\frac{J}{NA}$ a maximum, NA being the total chemical expenditure,

$$\frac{J}{NA} = \frac{\frac{L}{2}\left\{\frac{Ne}{R}\left(1 - e^{\frac{Rt}{L}}\right)\right\}^2}{N\left\{\frac{Ne}{R}\left[t + T\left(\frac{1}{e^{\frac{t}{T}}} - 1\right)\right]\right\}} \qquad (4)$$

By inspecting this equation it is seen that $\frac{J}{NA}$ is independent of N so that increasing the number of cells, the total resistance remaining constant, will in no way affect the chemical efficiency. This would require increasing the size of the cells as their number increases in order to maintain the same total resistance. An increase in the number of cells which simultaneously increases the total resistance would reduce the efficiency.

There are several conditions which affect the value of the resistance R. Referring to equation (1), it is seen that R

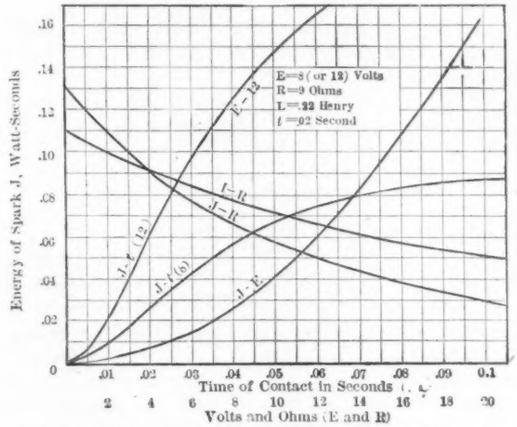


FIG. 3.—EFFECT OF VARYING THE RESISTANCE TIME OF CONTACT AND VOLTAGE.

enters into the equation in such a way that slight variations in R do not greatly affect the value of the current or the energy of the spark. This is illustrated in a special case by the current-resistance curve I-R of Fig. 3, and the energy of the spark, J, in the J-R curve of Fig. 3.

Treating equation (1) mathematically and solving for that value of R which will make I a maximum, other factors remaining constant, it is found to be zero, hence the smaller the resistance the more energy the spark contains. The rate of increase when reducing R is, however, not great, as shown in curves J-R and I-R of Fig. 3. Hence there is no gain in sacrificing anything else to obtain an extremely low resistance.

That value of R which will give the maximum efficiency in magnetizing the core may be determined by differentiating equation (5) with respect to $\frac{J}{A}$ and R, and solving for that value of R which will make $J \div A$ a maximum: A represents the coulombs or chemical expenditure per spark as above.

$$\frac{\frac{J}{A}}{} = \frac{\frac{L}{2}\left(\frac{E}{R}\left(1 - 2.718^{\frac{-Rt}{L}}\right)\right)^2}{\frac{E}{R}\left\{t + T\left(\frac{1}{2.718^{\frac{t}{T}}} - 1\right)\right\}} \qquad (5)$$

The maximum is found when R equals zero, which means that when R is as near zero as possible, practically all the voltage of the battery is used in overcoming the counter e. m. f. of self-induction; that is, in storing energy magnetically.

However, in operating an engine equipped with a touch spark, or a non-vibrating jump spark, ignition system it is found that the use of a coil of very low resistance frequently results in

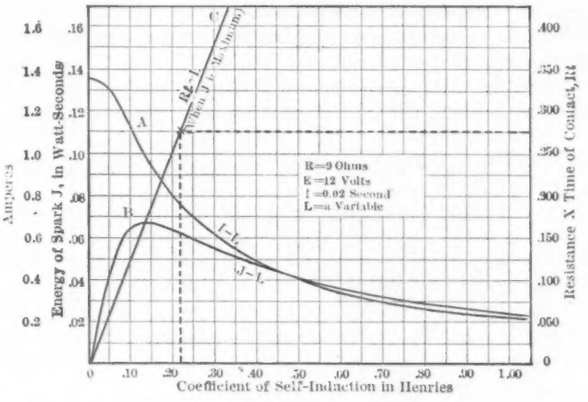


FIG. 4.—EFFECT OF VARYING THE SELF-INDUCTION, OTHER FACTORS BEING CONSTANT.

practically short circuiting the batteries when starting the engine, a few false starts resulting in throwing the batteries temporarily out of service as well as uselessly wasting their energy. Unless some automatic device is arranged to limit the starting current to a reasonable amount, the coil should have sufficient resistance in itself to afford the required protection.

The value of t, the length of the time of electric contact, is determined by the length of the arc of the contact, as measured on the periphery of the flywheel, and by the engine speed.

As shown by the general equation (1) the current will be a maximum when t is a maximum. But practically the current will reach its full value when $t = \frac{5L}{R} = 5T$. Thus, practically, the maximum spark will be obtained when $t = 5T$, except in cases of battery polarization, when the energy of the spark will decrease as the time of contact increases. For example, in Fig. 1, the energy of the battery is needlessly wasted when the current is allowed to flow for a longer time than $t = .05$ seconds.

The value of t which will render the efficiency a maximum is found as in the case of R above, the value of t being zero for maximum efficiency—that is, the less the time of contact the greater the efficiency. Thus, the point of cut-off should come on the steep part of the building-up curves, Fig. 1. Values should be selected for R and L so that the cut-off will occur at the proper moment, at least at the normal running speed. The point marked M in Fig. 1, near the "time constant," is a good efficient place at which to open the circuit.

The variations in t are shown in Fig. 2. For example, a 9.4-in. arc of contact on a 12-in. flywheel running at 1000 r. p. m. gives a length of time of contact of .015 seconds, as shown in dotted lines in Fig. 2. Upon the value of t depends the best value for L; the larger t is, the larger L should be.

The effect of varying t, as in the case of a variable-speed engine, is shown in curves A and B of Fig. 5, the one being for a 20 per cent and the other for a 10 per cent arc of contact, other conditions being the same in the two cases. See also curves

J-t (8) and J-t (12) of Fig. 3, plotted for an 8-volt and a 12-volt battery, respectively.

Regarding the self-induction, L, it is quite evident that if L is zero there will be no energy stored, and $J = 0$, while the current will reach its full $\left(\frac{E}{R} = I\right)$ value instantly, or at $t = 0$. On the other hand, if L is extremely large, the current will increase very slowly so that for any reasonable value of t, I will be very small and hence J also will be small. One should, therefore, determine not only what self-induction will give the strongest spark with any certain voltage, time of contact and resistance, but also what value of L will be efficient as to the consumption of electricity.

Curve A of Fig. 4 shows how the current values are affected by using coils of different amounts of self-induction, other conditions being unchanged. Curve B shows the resulting energy of the spark when varying the self-induction. It will be noted that an induction of 0.13 henry gives the spark maximum energy with $R = 9$, $t = .02$, and $E = 12$.

It will be most convenient to determine mathematically the value of L which will give the maximum J. Assuming J and L

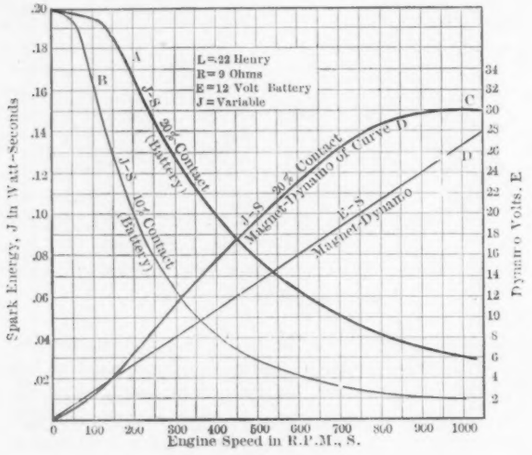


FIG. 5.—EFFECT OF VARYING THE SPEED.

to be variables, in equation (2) and substituting the value of I from equation (1), differentiating and putting $\frac{dJ}{dL} = 0$,

$$2.718^{\frac{Rt}{L}} = 1 + \frac{2Rt}{L} \qquad (6)$$

Having decided upon the values for R and t one may then determine, by trial, that value of L which will make the two sides of the equation equal. This value will be that self-induction which will give the maximum energy of spark in the particular case. The process may be reversed by assuming values for L and solving for Rt.

Curve C of Fig. 4, was drawn by solving for those values of Rt which would make J a maximum when L was .10, .15, .20 and .25 henry, respectively. As an example, when $L = .22$ henry Rt is .275; if R be 6 ohms then the time of contact, t, is $\frac{.275}{6}$ or .046 seconds. When L equals zero the current reaches its full value instantly and the stored (core) energy, J, equals zero, no matter how large the current. There may, however, be a spark, but it will be produced by the battery current only and have little disruptive character.

In order to find that value of L which will be most efficient so far as storing the magnetic energy, J, is concerned, one may proceed as before with equation (5) differentiating with respect to $\frac{J}{A}$ and L, as the variables, in order to find that value of L which will render the ratio of the magnetic energy, J, to the chemical expenditure, A, a maximum.

It is found that the larger is L the greater is the chemical efficiency. The effect of varying L upon the current and the energy of the spark is shown for a special case by curves A and B of Fig. 4. It is to be noticed that the current is a maximum when $L = 0$ and J is a maximum when $L = .13$ henry, for the values assumed, although there is little variation in J between .10 and .20 henry. The higher value of L should be selected because of the much greater efficiency. Compare curves A and B, respectively, and $L = .13$ and .26, Fig. 4.

Since the desirable value of L changes with t, or Rt, in the case of variable-speed engines that value of L should be used which is suited to Rt or t at the average or normal speed.

The amount of current to be used is determined by the energy of the spark, J, or core energy and the self-induction, L, the chemical efficiency being independent of I.

The dimensions and the best construction of cores and number of turns of wire to be used for a desired value of self-induction L will be taken up later in connection with the design of cores for different types of coils.

In the curves A and C of Fig. 5, a comparison is made between the energy of the spark supplied by a battery and a variable-voltage engine-driven dynamo; the time of contact, of course, varies inversely as the speed of the engine while the open circuit voltage of the magneto dynamo varies directly as the engine speed.

It is to be noted that the generator (curves A and C of Fig. 5) gives the same energy of spark as the battery at 450 r. p. m., the battery giving the stronger sparks at lower speeds. The engine speed at which the sparks from the two current sources are equal may, of course, be reduced by increasing the ratio of the dynamo speed to that of the engine; that is, by using a smaller dynamo pulley. The advantage of increasing the size of the sparks up to a certain point as the engine speed increases will be apparent. It is also desirable to have a strong spark in starting the engine.

In practice, the change from the battery to the dynamo is usually made by means of a throw-over switch, the battery being used only in starting.

It is to be noted in the case of curve C of Fig. 5 that the increasing dynamo voltage more than counterbalances the decreasing time of contact.

DESIGN OF CORES.

The selection of core dimensions is no doubt one of the most important and difficult problems in the design of spark coils, because the cross-section and length of the core not only determine the number of turns of wire which must be used to obtain the desired self-induction, L, but also to a large extent affect the resistance, R, of the coil, since the diameter of the core determines the length of the average turn of the winding.

The magnetic and constructional features can be eliminated from the discussion by recalling that the core should be of fine round shellacked iron wires of the best magnetic qualities. The finer the wires and the more perfectly insulated from one another the better, on account of the fact that the extremely rapid changes in the magnetic flux which occur in jump-spark coils tend to produce eddy currents in the core. The eddy currents act upon the core flux in the same way as a secondary current in a short-circuited coil; that is, they reduce the effective flux and greatly retard its rate of decrease.

Although it is not practicable to predetermine all of the dimensions of cores, if information is had concerning the constants of a coil and core which are of the same order as those of the coil to be designed, changes can be made in the first or experimental coil and the constants and results of such changes can be calculated. With these objects in view, several tests were made on iron cores in order to obtain a basis for calculating the dimensions of any spark coil.

A supply of commercial "annealed" round iron wire 0.062-in. in diameter was cut up into cores as follows:

The wires were slightly stretched in order to remove kinks.

They were then rolled between boards to completely straighten them, and shellaced, dried while lying cross-wise on one another, then gathered into bunches and pushed through suitable sized round holes in a board and taped as they came through.

The cores were of the following dimensions, 1 in. in diameter (180 wires) and 4 ins., 6 ins., 9 ins. and 12 ins. long, respectively, and 0.5 in. (45 wires), 0.71 in. (90 wires), 0.86 in. (135 wires) and 1.125 in. (225 wires) in diameter, respectively, by 4 ins. long.

Each core was wound with 191 turns of No. 16 copper wire in four layers, these coils being about 3 ins. long.

The magnetic flux for different ampere-turns on each core

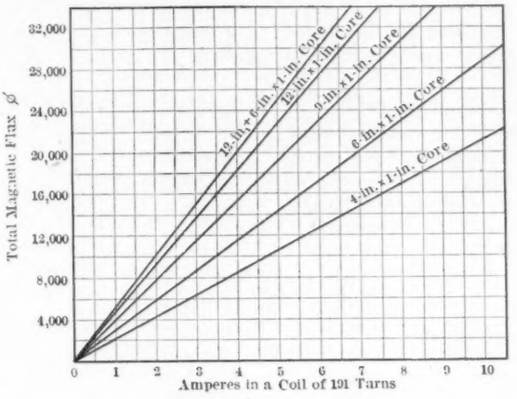


FIG. 6.—EFFECT OF INCREASING $\frac{l}{d}$ UPON THE NUMBER OF LINES OF FORCE ϕ AND THE EFFECT OF VARYING THE NUMBER OF AMPERE-TURNS.

was determined by means of a ballistic galvanometer and a 20-turn exploring coil wound on the outside of the 191-turn coil. Fig. 6 shows the total flux in lines of force for different magnetizing currents in the case of different lengths of cores, each 1 in. in diameter. It is to be noted that the magnetism in each case increases directly as the current, and also that it is greater the *longer* the core.

Fig. 7 shows the rate at which the magnetism may be increased for any certain magnetizing force (in total ampere-turns) by increasing the length of the core; in other words, by varying the ratio of the length to the diameter $\frac{l}{d}$ and keeping d constant. It is to be noted that increasing the length from 5 ins. (5 to 1) to 10 ins. (10 to 1) increases the flux, the

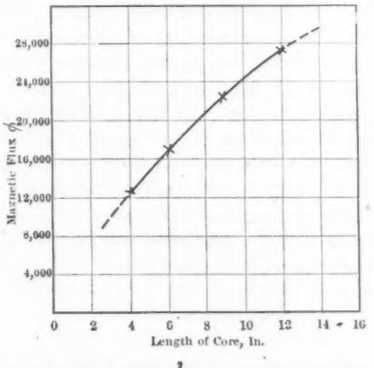


FIG. 7.—EFFECT OF INCREASING $\frac{l}{d}$ UPON THE NUMBER OF LINES OF FORCE ϕ.

current being six amperes, from 15,200 lines to 24,800, an increase of 63 per cent. An increase of 6 ins. (6 to 1) to 9 ins. (9 to 1) gives an increase of 41 per cent.

The effect of increasing the diameter of the cores, the length remaining 4 ins., is shown in Fig. 8. An increase in core diameter from .5 in. (8 to 1) to 1.125 in. (3.55 to 1) resulted in an increase in magnetic flux from 8400 to 16,800. The increase would be greater the greater the ratio of the length to the diameter — since the reluctance of the air path is relatively less the longer the core, so that a change in the number of iron wires would have a greater relative effect in the long cores; that is, in the cores having a large value of $\frac{l}{d}$.

The lines of force in the individual wires of the small cores (Fig. 8) were greater in number than in the larger cores, since the latter cores possess the greater relative reluctance in the air path. The lines of force per sq. in. in the .5-in. core above with 6 amperes were 63,000, while in the case of the 1.1125-in. diameter core they were only 25,000 per sq. in. of solid iron cross-section.

Annealing the cores by placing them in a length of gas pipe and heating them to a red heat, then cooling them slowly in a keg of lime increased the magnetic flux, other things being the same, about 3 per cent in the case of the 6-in. x 1-in core. Since the air part of the path of the lines of force has several times the reluctance of the iron core, the permeability of the iron was increased by much more than 3 per cent. In the case of long cores (large $\frac{l}{d}$) the effect of annealing would be much greater; that is, more than twice as much in case of the (12 to 1) 12-in. core.

For example, in the case of the 9-in. x 1-in. bending the wires back over the coil and forming a hollow horseshoe, doubled the magnetic flux, other things being equal. This relative increase, however, would be less the longer the core. Putting a few thin iron washers across the ends of the wires increased

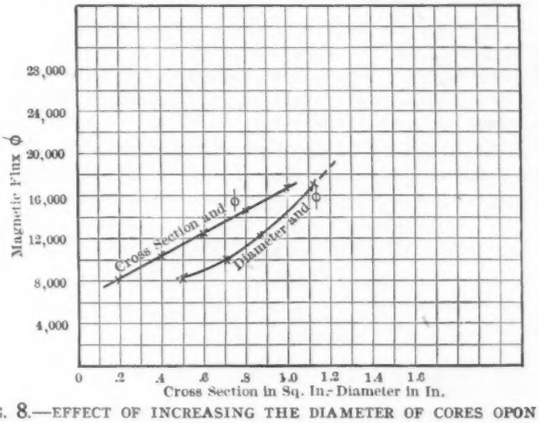


FIG. 8.—EFFECT OF INCREASING THE DIAMETER OF CORES UPON THE NUMBER OF LINES OF FORCE.

the flux again, by 170 per cent. Thus, closing the magnetic circuit, as shown above, nearly quadruples the flux in the case of the 9-in. to 1-in. core.

By comparison with the above results, the magnetic flux for a certain number of ampere-turns can be estimated for any ordinary spark coil, from which the flux per ampere of magnetizing current can be calculated. Then since,

$$L = \frac{N\Phi}{10^8}$$

in which N is the number of turns of wire and Φ is the flux produced by one ampere in the N turns, the self-induction, L, can be determined. For example, the 6 in. x 1 in. core has 20,000 lines of force with 7 amperes and 191 turns, or 1337 ampere turns (Fig. 6), hence,

$$L = \frac{191 \times \frac{20{,}000}{7}}{10^8} = .055 \text{ henry.}$$

With 2×191, or 382 turns, at the same flux,

$$L = \frac{382 \times \frac{20{,}000}{7 \div 2}}{10^8} = .022 \text{ henry.}$$

L thus varies as the square of the number of turns on the core.

Any desired combination of size of core and number of turns of wire can be found to give the desired self-induction by a few trial calculations.

In designing cores for vibrating jump spark and magnetic touch spark coils the magnetic pull of the core upon the vibrating armature must be considered. From the well known law of magnetic traction,

$$P = \frac{B^2 A}{8\pi}$$

in which P is the pull in dynes (approximately milligrams), B the number of lines of force per sq. cm. in the solid iron, and A the cross-section in sq. cms. of iron, it is to be noticed that the pull varies as the square of the magnetic intensity and only directly as the area.

Since increasing the length of a core, the ampere-turns remaining constant, will increase the magnetic flux, a rather long core should be used, thereby giving a large value to $\frac{l}{d}$.

The results noted from the curves may be summarized as follows:

1. The flux will increase directly as the magnetizing current and as the number of turns.

2. The greater the length of the core the greater the magnetic flux for the same ampere-turns.

3. The greater the diameter of the core the greater the flux.

4. The shorter the core (the less the value of $\frac{l}{d}$) the greater will be the relative reluctance of the air path and the less the magnetic density in the iron core.

5. The longer the core the less is the air-path reluctance and the greater the iron reluctance and the greater the density of lines in the iron with a certain magnetizing force.

6. The self-induction, L, varies as the square of the number of turns of wire.

7. L varies directly as ϕ, N remaining constant; hence, increasing the length or the diameter of a core will increase the value of L.

8. The longer the core (greater the vale of $\frac{l}{d}$) the larger the self-induction for a certain resistance of coil, and the greater the iron loss.

9. The shorter the core (less the value of $\frac{l}{d}$) the greater will be the resistance of a coil of a certain L.

10. Annealing will increase the flux by from 3 to 12 per cent, depending on the value of $\frac{l}{d}$.

OPERATING CONDITIONS.

There are certain operating conditions which apply in general to the kinds of apparatus under consideration. Operating characteristic features of jump-spark coils which are of interest to the designer and operator, are shown in the oscillograms of Fig. 9 where curve A shows the voltage of a primary battery of moderately high internal resistance, supplying energy to a vibrating jump-spark coil. The "kick" which occurs in the primary coil is shown by the rise in voltage NH. The irregularities at K are due to a similar cause occasioned by a slightly chattering vibrator. Curve B shows the instantaneous values of the current in the primary coil. The line at K should be as nearly horizontal and smooth, NH as nearly vertical and MN as nearly straight as possible. The spark or secondary current HNP of curve C lasts about 0.001 second, varying inversely with the length of the spark gap, with the engine compression, etc. Curve D is not an oscillogram, but it has been drawn from known conditions. The secondary or jumping pressure VS may be measured by noting the length of the spark gap and the compression pressure. The voltage necessary to sustain the arc is not known exactly either in form or in amount, except that it is probably tens of volts.

Attention should be called here to the distinctive difference between the jump spark and the touch spark. The secondary voltage rises instantly on the cessation of the primary current, to V of curve D, as the secondary or spark current starts. Further, the shorter the arc (gap) and the less the compression pressure the larger the secondary current will be, and the longer it will continue. In other words, the longer the gap and the higher the secondary voltage the more of the spark energy is involved in the disruptive or detonative discharge VN, of curve D. The "kick" of a touch spark comes *after* the spark has started and hence has little disruptive or detonative effect.

The secondary voltage, up to the maximum jumping voltage of which the coil is capable, varies directly with the length of the spark gap and the absolute compression pressure.

While a long spark gap may have greater ignition power than a short one, probably largely owing to its disruptive character,

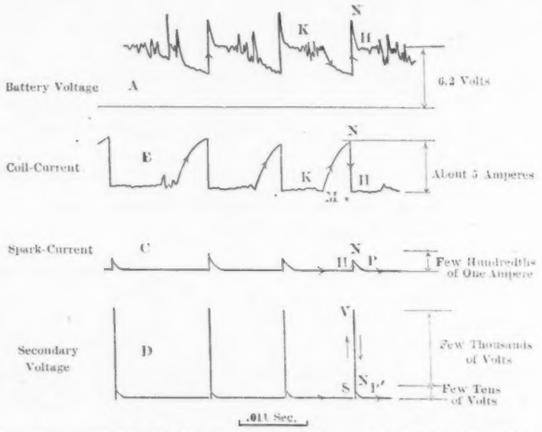


FIG. 9.—OSCILLOGRAMS OF A VIBRATING JUMP-SPARK COIL.

the troubles liable to follow the use of a long spark gap must be borne in mind. They are liable to produce short-circuited spark plugs, secondary coils, etc.

TOUCH-SPARK COILS.

The design features of touch spark coils may be summarized as follows: With a battery as the source of supply, the e. m. f. should be not less than from 6 to 8 volts, depending upon the engine. The resistance should be as small as possible both in respect to the coil and as to the internal resistance of the battery and the wiring. The time of contact should extend throughout about 20 per cent of one fly-wheel revolution. The coefficient of self induction should be as large as possible, and still obtain a sufficiently strong spark with the values of e. m. f., resistance, and time of contact. If possible a value of L should be selected which is at least twice as large as that value of L which will give the maximum energy of spark as shown above in connection with Fig. 4.

In general such values of R, t and L should be selected as will bring the cut-off of the current at not more than 63 per cent of the full $\frac{E}{R}$ value. The time, t, in such a case will be equal to the "time constant," which is equal to $\frac{L}{R}$, and will result in good efficiency.

The core should be built up of very small iron wires carefully annealed and varnished. The diameter of the core should be large and the ratio of the diameter to the core length $\frac{l}{d}$

should be large, such as 10 or 12 to 1. Of course, the whole coil may be increased or decreased in size according to the desired energy of the spark.

When the source of supply is a dynamo, the e. m. f. should be from 10 to 16 working volts. The resistance should be somewhat large since the current is to be small and the coil may be wound with rather fine wire; or R may be selected just small enough so that the armature reaction of the dynamo will limit the energy of the spark at high engine speeds. The time of contact, t, may be from 20 to 25 per cent of one revolution. The coefficient of self-induction, L, may have any value which will give the desired energy of spark, since the efficiency is of no particular importance.

A short thick core of small shellacked iron wires will provide a satisfactory coil; annealing is not worth while.

In the case of a magnetic touch-spark plug with a variable-speed dynamo and a battery as a source of supply, the available space would determine the shape both of the coil and core to a large extent. The e. m. f. should be from 8 to 10 volts for the battery and from 10 to 16 volts for the dynamo. Generally the battery would be used in starting, and a plain direct-current magnet-dynamo would be used for the lowest running speed and above. This combination would give constantly increasing voltage and spark with increased speed and with decreasing igniter lag.

The resistance should be rather large, because of the small space, in order to obtain a large number of turns on a small core.

The value of L should be as large as possible with the large value of resistance used.

A small igniter lag is desirable. The time of contact should be nearly as small as that of an ordinary vibrating jump-spark coil, that is, from 0.005 to 0.010 second.

The energy of the spark need not be so large as in the case of the ordinary touch-spark coil, because there would then be a series of sparks at each explosion, when starting.

NON-VIBRATING JUMP-SPARK COIL.

The primary coil of a non-vibrating jump-spark coil in general follows the design of a touch spark coil as discussed above. The voltage may be relatively lower (from 6 to 8 volts) and the current larger, owing to the fact that a good contact is possible at all times in the timer. The resistance of the primary coil is generally small, owing to the use of a low voltage source which results in a coil of small self-induction with few turns of wire.

In case a dry battery is used in starting and a dynamo, either of the constant or variable-voltage type, is used at all speeds above the minimum, there is no particular advantage in using large wire on the primary coil to keep the resistance low. In fact, it is a distinct advantage to use small wire in order to get the secondary coil as near the core as possible.

The time of contact should preferably be a constant one, in case the voltage supply is constant, but if a dynamo is used which gives a rising voltage with increase of speed, a fixed arc of contact of approximately 20 per cent of one engine revolution, should be perfectly satisfactorily.

Inasmuch as the number of secondary turns necessary is directly proportional to the quickness with which the primary current is stopped, a timer of the "snap break in oil" type, having hard platinum alloy contact points, should be used. This detail has more to do with the jumping power of a coil than any other constructive feature. These coils have practically a zero igniter lag.

In order still further to assist in stopping the primary current quickly a condenser should be connected with one terminal on each side of the timer contact points to accept the flow of electricity while the contact points are being separated in the timer. This condenser should have the smallest resistance possible and the least capacity in micro farads possible in order to prevent arcing in the timer, as determined by trial.

As already stated, L may be small as compared to the value used with a touch spark coil because a rather large current at low voltage is usually employed.

The amount of energy, J, stored in the primary coil, should be about the same as that of a touch-spark coil, since the greater igniting power of the jump spark is counterbalanced by the lower efficiency of all jump-spark coils.

The core of a jump-spark coil possesses some features entirely distinct from those of a touch-spark coil. If the coil is to be used with a battery as the only source of supply, the core should have a large ratio of length to diameter $\left(\frac{l}{d} = 12 \text{ to } 1\right)$ but it must be long in any case so that the core, and the primary coil as well, may project well beyond the ends of the secondary coil in order that all the lines of force may enclose all the turns of the latter. In order to insure a quick break, *eddy currents must be reduced by using fine iron wire well varnished.*

Annealing will greatly increase the efficiency of the equipment inasmuch as a long core is to be used.

The secondary coil should have the least possible number of turns which will give to the coil the necessary jumping power, and it should also have as little resistance as possible so as to obtain a high efficiency. The requirements can be met by the use of a closely wound primary coil with thin insulation, having high dielectric strength, between it and the core, a *thin* insulating tube of rubber or built-up mica between the secondary and the primary coils, a long secondary coil, if possible of *one section,* and wound with wire as large as the space will permit.

In case the secondary e. m. f. is to be very high such as that required to jump 1.0 inch between needle points in air (26,000 volts) it may be necessary to wind the secondary coil in two or more sections to prevent sparking between successive layers. The second section of the secondary coil should have an extra thick insulating tube between it and the primary coil. *A one-section secondary is better and cheaper if it can be used.*

The number of turns in the secondary coil should decrease in general with an increase in the length and diameter of the core. The benefits of a very large increase in the size of the core, however, are soon overbalanced by magnetic leakage, by the slowing up effect of the eddy currents in the core when the core is large compared to the secondary coil, and by the resulting increase in the resistance of the secondary coil. Moreover, no core should be used which will not allow the use of full layers of primary winding of suitable sized wire.

SECONDARY SAFETY SPARK GAP.

The insulation of many jump-spark coils is broken down by allowing the secondary coil to generate an excessive voltage. The voltage can be limited by determining the maximum safe e. m. f. and then connecting the terminals of the secondary coil to a "safety" spark gap of a proper length, placed upon the case of the coil and connected in parallel with the spark-plug gap. The "safety" gap will also act as a tell-tale to indicate the accidental opening of the secondary circuit.

SECONDARY INSULATION.

The secondary coil should not be subjected to high voltages until the whole coil has been thoroughly "filled" with a suitable insulating compound by the heat-vacuum process. Every trace of air and moisture should be eliminated from the coil, otherwise the insulation will soon break down. Many kinds of insulating materials are used for this purpose, such as paraffin, which is not very good because it absorbs moisture, and various combinations of beeswax, resin, etc. Mosciki's mixture, consisting of four parts of resin, one part of ozokerite and one part of vaseline should give good results, because it has a very high dielectric strength.

During the experimental stages of the building of a jump-spark coil it may be immersed in common kerosene for the trials, and there is no reason, so far as the insulation is concerned, why a liquid oil should not be used at all times instead of wax.

The energy of the spark from a non-vibrating jump-spark coil may be increased by increasing the voltage, decreasing the resistance of the source, and by increasing the arc of contact or

the time of contact up to a value which is equal to about five times the "time constant" $L \div R$.

VIBRATING JUMB-SPARK COILS.

The design of a vibrating jump-spark coil conforms to the conditions noted above for a non-vibrating coil design, with a few minor exceptions. In general, the coil may be slightly smaller as it is not necessary in case of a series of sparks during one ignition that each spark be as strong as the single spark of a non-vibrating coil. The jumping power should be nearly equal to that of a non-vibrating coil, but this can be obtained with a smaller secondary coil, because as a rule a quicker break is given with a vibrator than with a timer. *A quick non-arcing break at the vibrator is absolutely essential.*

Many tests show that the great difference noted in the operation of jump-spark coils lies principally in the vibrator design.

The contact terminals should be large and perfectly flat, and the vibrator movement should be *so arranged that all parts of the contact are broken at the same time.* The time between the beginning of the movement of the contact point and complete separation should be not greater than the "time constant" of the vibrator condenser, as, for example , a condenser having .10 micro farad and .01 ohm resistance would receive 63 per cent of its full charge in RC seconds or in $.01 \times .000010$ sec., or *one ten millionth part of one second.* If the above condition is not fulfilled the condenser will become charged before the points are entirely separated and sparking will result. The contact points should be the hardest, non-fusible, non-volatilizable metal obtainable, such as iridium-platinum.

A mica insulated condenser of the least resistance possible and of the smallest capacity possible (to be determined by trial) should be used in order to prevent arcing. Mica is preferable to paraffined paper for insulation for it not only has a much greater dielectric strength but has greater specific inductive capacity and a greater free discharge capacity.

The use of the vibrator does not necessarily introduce any change in the relative core dimensions as compared with those for a non-vibrating jump-spark equipment, except, perhaps, that the core should be slightly longer in proportion to its diameter in order to take advantage of the fact that the greater concentration of the lines of force in a small core will give greater pulling power to the vibrator. As stated above, the pull increases as the square of the number of lines of force per square inch and directly as the cross section of the core.

In general the primary coils are wound for rather low e. m. f. (6 to 8 volts) in order to limit the number of cells and also to keep the voltage at the vibrator well below the limiting arc sustaining pressure. Not much more than 12 volts should be used in case the supply of energy is obtained from a dynamo.

Owing to the fact that any change either in the resistance or the voltage of the sources of pressure requires a readjustment of the vibrator to obtain the best operation of the coil, vibrating jump-spark coils are strictly *constant potential coils.* A non-inductive source, such as a battery, is better than an inductive one for a vibrating jump-spark coil.

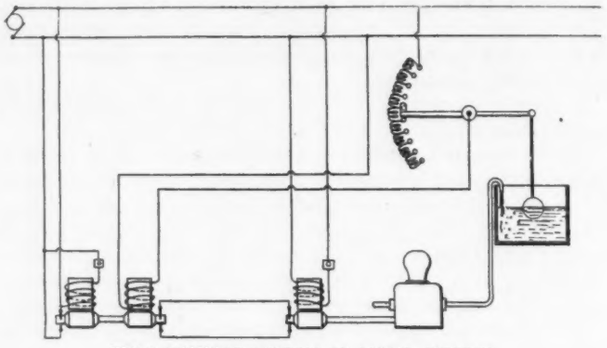
A vibrating jump-coil should have a constant time of contact at the vibrator. In many coils the first contact is made for a longer time than later ones, owing to the accelerating effect of the rebound of the vibrator. Inasmuch as the duration of the first contact is the igniter lag, the time should be as short as possible, especially for high-speed engines. The time of contact may be decreased by setting the vibrator close to the core, adjusting the spring tension and increasing the voltage.

Generally speaking, any coil designed for very high speed, that is, with small igniter lag, will give a large number of *small sparks* per explosion and will require a small average primary current when vibrating continuously.

The energy of the sparks may be increased by increasing the voltage of the source, by increasing the spring tension and by setting the vibrator farther from the core. The adjustments, however, will result in an increasing energy of secondary spark only when the changes do not cause sparks at the vibrator contact points.

Speed Control of Direct-Current Motors.

A patent issued Nov. 26 to Mr. H. Ward Leonard is interesting both on account of the means employed and by reason of the early date of the original application, Feb. 6, 1897. In many respects the system described resembles the motor-generator locomotive system with which the name of the above inventor is associated, as seen from the accompanying illustration, which shows a direct-current motor driving a pump for



WARD LEONARD SYSTEM OF MOTOR CONTROL.

filling a tank with water. The field current of this motor is obtained directly from the main supply leads, but the armature current comes from a special motor-driven generator whose field strength depends upon the depth of water in the tank.

Preservative Treatment of Poles by the Open-Tank Process.

By D. A. Rockwell.

In the work which has been done in connection with the preservative treatment of telegraph, telephone and transmission line poles it has been considered that, compared with other preservatives, dead oil of coal tar is the most efficient and the most economical in the long run. Carbolineum, which is in reality a refined dead oil of coal tar, may have a limited use.

Timber may be treated with dead oil of coal tar by three methods, namely, the closed-cylinder method, the open-tank method, and the brush method. The relative efficacies of the methods are undoubtedly in the order stated.

The open-tank method differs from the closed-cylinder process in that tanks or vats, which are open to the air, are employed. The open-tank process, in that it does not necessitate the use of expensive cylinders and auxiliary apparatus, promises to effect, by reduction of plant costs, considerable economies in the preservative treatment of timber. Another advantage offered in the case of poles is that the portion of the pole subject to the maximum decaying action, that is, the butt end, can be selectively treated. This procedure results in a considerable saving of preservative compound. The possibility of treating poles at a comparatively small cost so as to obtain thereby an increased life of several years should insure a considerable field for the application of the open-tank process.

There are two distinct methods of carrying out the open-tank process of treatment, the single-tank method and the double-tank method.

SINGLE-TANK METHOD.

In this method, the timber under treatment is placed in the tank and covered with dead oil of coal tar, means being taken if necessary to prevent the timber from floating. Heat is applied to the tank, either by a fire built beneath the tank, or, preferably, from the standpoint of fire hazard, by steam coils placed within the tank, and the oil maintained at a temperature of from, say, 212 deg. F. to 230 deg. F., for several hours, depending on the size and character of the timber. As a result of this heating, the air and moisture are expelled from the wood structure, which fact is indicated by a seeming ebullition of the oil.

This method may be carried out in two different ways: *a* With change of oil; *b* without change of oil.

When the heating process has been sufficiently prolonged, the hot oil can be run out of the treating tank into the emptying tank, method *a*, and the treating tank quickly refilled with cool oil from the storage tank. The oil storage tanks and connecting pipes should be so proportioned that the emptying and refilling process can be carried out in a short time, as an exposure of the treated surface to the air between the hot and cool oil baths is liable to react on the oil penetration. The timber is allowed to remain in the cool oil bath for an interval of time such as experience shows sufficient to ensure the desired penetration.

Instead of emptying the treating tank between the hot and cool baths, the valves of the connecting pipes may be so arranged that the oil level in the treating tank is maintained substantially constant during the change of oil. If the supply tanks are of sufficient size, the temperature of the oil in the treating tank will be considerably lowered by this procedure.

In method *b* the heat supply is shut off at the end of the heating interval, and the oil is allowed to cool by atmospheric radiation. The results obtained by this method are essentially the same as with a change of oil. This method has been successfully followed in the experimental treatment of cedar and chestnut poles, and Norway pine cross-arms.

Method *b* would probably require a longer time for treatment than method *a* owing to the slower process of oil cooling. However, if it is desired to make only one run per tank per day, that is, heating during the daytime and allowing the poles to remain in the cool or cooling oil during the night, then method *b* offers certain economies in plant cost. As it is not necessary to empty the treating tank in order to recharge with poles, the emptying tank is not required. The storage tank can be used in method *b* if it is desired to store considerable oil at the treating plant. Such a tank greatly facilitates the handling of the oil, as otherwise it is necessary to fill the treating tank from barrels.

DOUBLE-TANK METHOD.

In this method two tanks are provided, one for the hot bath and one for the cool bath. After the timber has been in the hot bath for a sufficient length of time, it is transferred to the cool bath and allowed to remain therein for the necessary time. The question of the exposure of the treated surface enters, however, and, as several minutes might be required to transfer a pole from the hot to the cool bath, it is not felt that the method should be carried out in practice until further experimentation has determined what exposure of the treated surface, between the hot and cool baths, can be made without reacting on the depth of oil penetration into the wood structure.

A disadvantage of the method is the increased cost of handling incident to the transfer of the poles from the hot to the cool oil tanks. This method presents the advantage, however, that the treatments can be carried on without interruption, as both the hot and the cool tank can be kept filled with poles.

Experiments made in 1905 by the Forest Service showed that penetrations through the sap wood could be obtained on partially seasoned and seasoned cedar and chestnut poles. The results on green poles were not as satisfactory, the penetrations being somewhat irregular. Winter cut poles, after the outer bark is removed, have an almost impervious layer of inner bark which adheres to the green wood, but wherever this inner bark layer is removed, the oil penetrates the sap wood. It is probable that, by shaving the butts of green poles, good penetrations could be obtained, but it is considered advisable at present to limit the open-tank treatment to seasoned or partially seasoned poles, by which it is established that good results can be obtained.

In connection with the treatment of seasoned cedar and chestnut poles, it is fair to assume that a 30-ft. pole will on the average absorb at least 50 lbs. (about 6 gals.) of dead oil of coal tar.

Seasoned loblolly pine can be treated easily by the open-tank method. This timber seasons in a few months in the South, and the treatment of loblolly pine poles can be carried out without an undue holding for seasoning.

About 5000 seasoned Norway pine cross-arms have been treated by the open-tank process with excellent results. An average absorption of about 12 lbs. of dead oil of coal tar per cross-arm was obtained.

PLANT REQUIREMENTS.

In the design and construction of open-tank treating plants, it is necessary to consider the following factors as reacting on the design: 1. Location of the plant and accessory apparatus as affecting the ease and economy of handling poles and oil. 2. Reduction of heat radiating surfaces to a minimum. 3. Means of keeping timber below the oil surface. The last factor does not enter into the pole treatment, but in the treatment of seasoned cross-arms; for example, it has been found necessary to adopt means to keep the arms submerged at the beginning of the treatment.

The effect of a proposed treating plant upon the insurance of the surrounding property should be ascertained before a definite location is selected. In plants heated by steam the fire hazard should be small if the boiler is somewhat removed from the storage and treating tanks. Dead oil of coal tar at ordinary temperatures does not take fire easily, but after catching fire it burns fiercely; such a fire is best controlled by throwing sand upon it.

The apparatus necessary for the operation of method *b* is a treating tank with steam heating coils, a source of steam supply and a derrick for handling poles and oil barrels.

Method *a* requires, in addition to the above apparatus, a storage tank for dead oil of coal tar, an emptying tank, and a pump for the transfer of oil from the emptying tank to the storage tank, and from the tank-car to the storage tank.

The size of the treating tank is dependent primarily upon the number of poles which it is desired to treat per charge, and also to some extent upon the source of steam supply for heating. The depth of the tank is controlled by the longest poles which are to be treated at the plant. The greater the height of the tank above the ground level, the greater the difficulty in loading and unloading the tank. A tank 8 ft. deep will treat the butts of poles up to 40 ft. in length, and a tank 9 ft. deep up to 50 ft. Occasional poles of greater length than these could be treated by placing them diagonally in the tank and regulating the oil level to the proper height on the pole. To facilitate the handling of poles, the tank should be set as much below the ground level as is compatible with the requirements for steam circulation. A ¼-in. steel tank with lap-riveted joints, and properly braced, should be satisfactory.

The oil in the treating tank should be heated by means of steam pipes arranged on the bottom of the tank. The heating pipes may be in the form of a return-bend coil, or, preferably, of a coil made up of branch T's. The latter form would provide a better steam circulation. Although there is very little information relative to the heating of open-tanks filled with dead oil of coal tar, it is estimated, on the basis of theoretical considerations, that, if steam is supplied at a pressure of 100 lbs. per sq. in., a steam pipe area of 0.075 sq. ft. per cubic foot of oil will raise the temperature of the oil at a rate of between 1 deg. F. and 2 deg. F. per minute. The steam coils should be protected from possible injury, as the dropping of poles upon them, by being coiled about I-beams or rails, the protection being placed so that the smallest poles to be treated will not pass between the beams or rails and strike the coils.

If the bottom of the tank is located lower than the steam boiler, it will be necessary to install a condensing steam trap, condensing well, and an injector or circulation pump, if it is desired to return the condenser water to the boiler.

The steam supply should, if possible, be sufficient to raise the temperature of the oil to 220 deg. F. in from two to three hours, which would correspond to a temperature rise of the oil of from 1 deg. F. to 2 deg. F. per minute. Assuming a combustion of about 8 lbs. of coal per square foot of grate surface and an evaporation of 8 lbs. of water per pound of coal, it is estimated that a grate surface of about 0.035 sq. ft. per cubic foot of oil will be ample. These assumptions are based on the

use of vertical boilers of the type used with hoisting engines and a medium efficiency of coal combustion.

In calculating the requisite steam pipe and grate surfaces for any treating tank, it would undoubtedly suffice to assume the oil volume as one-half of the tank space at the highest oil level to be maintained in the tank. It may be considered, for purposes of calculation, that the oil will be heated before the poles are placed in the tank. Even if the poles are in the oil during the initial heating process, the oil will probably absorb the greater portion of the heat owing to the poor conductivity of wood. After the oil has reached the maximum temperature, sufficient heat must be supplied to overcome the loss of radiation and the heat absorbed by the wood.

The supply of steam can, if desired, be controlled by means of a thermostatic regulator set to maintain a maximum temperature of 220 deg. F.

If the treating plant is situated near a steam plant of considerable size, it will probably be more economical to obtain the steam from that plant in preference to installing a special boiler for heating purposes.

As the steam is required at the maximum rate during only the heating of the oil, it would undoubtedly be possible to furnish from one small boiler steam necessary for heating the storage tanks, tank cars, circulation and oil pumps, and for a steam winch in connection with the derrick for handling the poles.

The oil storage tank for large plants should have a volume of at least 25,000 gals.; that is, somewhat in excess of two oil-tank cars. The tank should be provided with steam heating coils in order to maintain the temperature of the oil above the temperature of solidification. The storage tank should be placed at a height sufficient to enable the filling of the treating tank by gravity. The connecting pipe between the storage and treating tank should be at least 10 ins. in diameter and controlled by a valve. The storage tank should be equipped with a float gauge to indicate the height of oil in the tank.

The emptying tank should be placed underground so that the oil will flow into it from the treating tank by gravity, and should be of somewhat greater volume than the treating tank. The connecting pipe should be at least as great in diameter as the pipe between the storage and treating tanks.

The treating tank should also be joined to the emptying tank by means of an overflow pipe connected at different heights with the treating tank. By opening proper valves, the oil level in the treating tank can be maintained at the desired height. It will not be necessary to place heating coils in this tank if care is taken to pump the oil back into the storage tank before it has cooled to the temperature of solidification. The tank should be provided with a float gauge as an indicator of the depth of oil in the tank.

A steam-driven pump should be provided for transferring the oil from the emptying tank to the storage tank. The pump would also be used when filling the storage tank from tank cars.

A derrick should be provided in order to facilitate the transfer of the poles into and from the treating tank. The derrick could, if desired, be operated by a hoisting engine, the steam being supplied from the heating boiler.

Central Station Progress in Montreal.

The Montreal Heat, Light & Power Company has recently moved into a commodious new building of its own at the corner of Craig and St. Urbain Streets, opposite the Street Railway Chambers. The new home of the company has been appropriately christened the Power Building, and is located in the business center of the city, close to the post office and the leading banks. Since the formation of the company in 1901, out of divergent elements, among which were the Royal Electric Company, the Lachine Rapids Hydraulic & Land Company, Ltd., the Montreal Gas Company, the Standard Light & Power Company and several suburban organizations, it has been handicapped for lack of space and proper accommodation. Although the building is not quite completed at this writing, it has been constructed to afford the public and the company every convenience for the speedy transaction of business.

The new building is a steel frame structure of seven stories and a basement, about 100 ft. square and 125 ft. high above the ground level. Its exterior walls are of Indiana sandstone. The basement will contain vaults and storage room, with space for sub-station equipment if necessary. On the first floor will be the contract department and office of the general agent, Mr. J. J. Cagney, adjoining a display room, containing 1000 sq. ft. of exhibition space, provided with gas and electric outlets, and in which will be a large illuminated display of gas, electric lighting, heating, cooking and power apparatus. Electric elevators and a local branch telephone exchange of 50 stations will keep the various departments in close touch with the public. The building is heated by steam transmitted underground from the company's steam plant on Chenneville Street. The second floor will contain the construction and operating department offices; the third, the executive offices, boardroom, the offices of the president, vice-president, secretary and treasurer, and of the auditing and legal departments. The fourth, fifth and sixth floors will be rented, and the seventh will contain a convention hall and lunchroom for employes.

It is only fair to attribute the steady growth of Montreal during recent years to electric power utilization. The local street railway is operated by energy obtained in part at Shawinigan Falls and transmitted 87 miles to the city; while the company is also supplying energy to the Dominion Textile Company, the plants of the Montreal Water & Power Company, the Montreal Steel Works, the American Locomotive Company, the Dominion Steel Car Company, the Simplex Railway Appliance Company, the Robert Mitchell Company, Ltd., the Jas. Robertson Company, Ltd., the Montreal Rolling Mills Company, the Dominion Oil Cloth Company, Ltd., oil and flour mills, the Grand Trunk and C. P. railroads, Dominion Park and many other large consumers, constituting about 75 per cent of the users of energy on the island of Montreal. Twenty cities and towns surrounding the city are also lighted by the company. As has been remarked in these columns before, Montreal consumes more electric energy per capita than any other city in the world.

While the price of practically all other commodities has been increased of late, the price of gas and electricity has been steadily decreased, notwithstanding the greatly augmented cost of labor and material. In 1854 the price of gas in Montreal for lighting and fuel purposes was $4.20 per 100 cu. ft., while to-day the prices of gas for lighting and cooking are $1.20 and $1.00, respectively. Similarly, the price of electric lighting service has been reduced from $11 per 16-cp lamp per year in 1884 to a basic meter rate of 15 cents per kw-hour, subject to varying rebates, depending upon consumption, under which the cost of burning a 16-cp lamp during ordinary lighting hours does not exceed $3 per year.

The rates for motors now obtaining in the city are lower than ever before at Montreal. In 1894 the Royal Electric Company was supplying the equivalent of 14,700 16-cp lamps and 50 hp in motors; its total number of customers did not exceed 300, and none of the various heating appliances were heard of. At present the Montreal Heat, Light & Power Company has connected to its system the equivalent of 450,000 16-cp lamps, about 37,000 hp in motors, and upwards of 1000 appliances for heating, cooking, refrigerating, etc. The company serves upwards of 13,000 electric consumers and about 50,000 gas consumers, or a total of nearly 70,000 consumers.

The company's motor rates are of particular interest in view of the success which has been attained in the broadening of the load curve. Non-peak power users are encouraged by a special concession, as will be seen by the following brief discussion of the rates at present in force. The services are classified as follows:

Unlimited day service, 10 hours straight, 7 a. m. to 6 p. m.

Unlimited day and night service, 24 hours, continuous.

Limited day service (off-peak) from 7 a. m. to 6 p. m. throughout the year except from 4 to 6 p. m. between Sept. 15 and March 15.

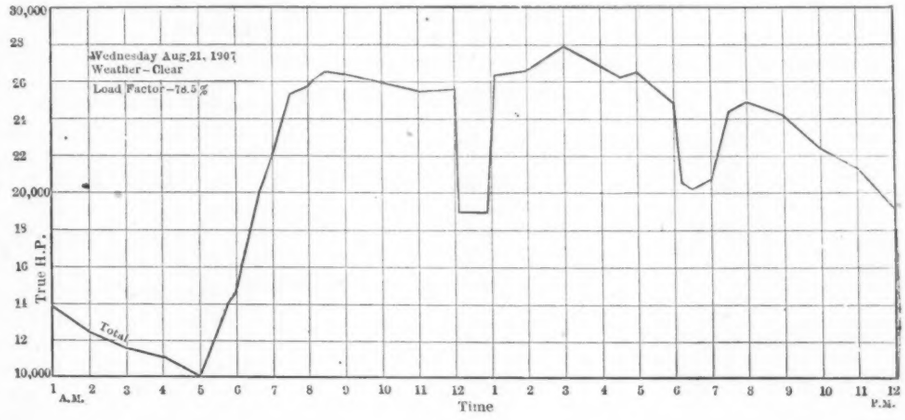
Limited day and night service (off-peak) 24 hours per day throughout the year except between 4 and 7 p. m. between Sept. 15 and March 15.

On the limited day service the reductions given by the company amount to 25 per cent of the unlimited day rate. The same ratio of difference applies to the unlimited day and night service and the limited or off-peak day and night service.

Three systems of charge, equalizing one another under certain load factors, are in vogue, as follows:

1. A straight flat rate per hp-year, varying acording to the average maximum load as determined by test.
2. A readiness-to-serve charge based on average maximum demand plus a meter charge per hp or kw-hour, also varying according to demand.
3. A straight meter rate per kw-hour or hp-hour as the customer chooses, likewise varying according to demand.

The results of encouraging the non-peak business are seen clearly in the accompanying diagram, which is a reproduction of the total load curve of the company on Wednesday, Aug. 21, 1907. The shape of the curve is remarkable for a central station, and its load factor of 78.5 per cent speaks volumes for the steadying influence of a very large power output. The load in general falls off in the early morning hours to 10,000 hp, rising to a well-sustained maximum average of about 26,000 hp during the forenoon. During the lunch hour, 12 to 1, the load fell to 17,000 hp. The afternoon peak occurred at 3 p. m., 28,000 hp, the high average of about 27,000 hp being well sustained between 1 and 5 p. m. The falling off of the power load during the latter part of the afternoon is conspicuous, and the occurrence of a minimum of 20,000 hp at 6:30 p. m. is of special interest as indicating the preponderance of motor load in the company's total load output. At this time of the year the lighting load is, of course, late in coming upon the machines, and the 8 p. m. maximum of 25,000 hp is soon over, with a rapid fall in output between 8 o'clock and midnight. In the 12 hours between 7 a. m. and 7 p. m., the company's motor load represents a most unusual constancy and volume, and it bears eloquent testimony of the economic value of hydro-electric power when scientifically distributed in a large manufacturing city.



LOAD CURVE.

It has been found that about 40 per cent of the company's customers can cut off power at the time of peak load without detriment to themselves. Among the loads are 3500 hp in cotton mills, which start at 7 a. m. instead of 8, and which allow half an hour for lunch, stopping work at 4:30.. The operatives in many instances prefer to follow these hours and go home early than to begin later and close later. Among these off-peak consumers are the various morning and afternoon newspapers, to whom the company supplies upwards of 400 hp. Another class of customers is found in brick yards. These require entirely a summer service, and get about 50 per cent of the regular rates on seven months' operation. These amount to 600 or 700 hp, the motors being used to drive casting machines, mixers and conveyors. Other non-peak users are the local water power company, which uses 1200 hp in pumping drinking water; the Railway Appliance Company, 500 hp; various wood yards and cement works. In the wood yards all the cutting is done during two or three hours of each day. From 5000 to 6000 hp will be used in the cement industry at Montreal next year. The non-peak rates are as yet given only to trustworthy customers consuming relatively large amounts of power. An installation of 20 or 25 hp would be about the limit below which the non-peak rate would not as yet be granted. Separate circuits are not run and the time switch has not yet been applied to any extent, though the latter is being considered by the company. The company makes a special rate for electric heating wherever the installation is large enough to warrant.

The company controls practically all the developable or commercially practicable water powers within transmission distance of Montreal. The present plants include a 12,000-hp station at Lachine Rapids; a 22,500-hp plant at Chambly on the Richelieu River; the selling rights in Montreal of the large Shawinigan plant, and 8000 hp in steam plants on Queen Street and elsewhere in Montreal. A new plant is now being built on the Soulanges Canal, about 38 miles from the city. This will contain three Canadian Westinghouse 4400-volt, three-phase generators of 5000 kilowatts rating each, direct-connected to Allis-Chalmers-Bullock turbines of the horizontal shaft type, four turbines being provided per unit of generating capacity. The head upon the turbines will be 50 ft. The power house will be a concrete structure, 150 ft. long by 43 ft. wide, and the transmission potential will be 44,000 volts, three-phase. Mr. R. S. Kelsch, of Montreal, is the consulting engineer for this work.

The commercial service of the company consists of 550-volt three-phase, 63-cycle current throughout the industrial territory; 220-volt and 110-volt single-phase lighting service. There is also a 250-volt, direct-current motor circuit used mainly for electric elevators, the charge for this service being about 25 per cent more than for alternating current on account of the losses in conversion and distribution. The minimum power-factor of motors when operating the consumer's maximum load is required to be as follows: Motors not exceeding 5-hp rating, at least 75 per cent; motors of over 5 hp, and not over 10 hp, 80 per cent; motors over 10-hp rated capacity, 85 per cent.

During the year ending April 30, 1907, the gross earnings of the company were $3,453,000, and the net profits, after providing for fixed charges, were about $1,440,000, being an increase in gross over the preceding year of over a quarter of a million dollars, and an increase of about $162,000 in net, despite the increased cost of labor and material. The company completed during the year the erection of a dam on the Richelieu River, at Ste. Thérèse, for storage purposes, at the same time drowning the rapids at that point with the object of obviating the troubles experienced in past years at the Chambly plant from frazill ice. The experience of the past winter fully demonstrated the value of this dam. A 2000-hp steam turbine unit has also been added to the steam plant at the Queen Street Station. The increase in electric connected load during the year was 41,665 incandescent lamps, 266 commercial lamps, 33 street lamps, and 4884 horse-power in motors.

Steel Transmission Towers on the Jersey Meadows.

The new line of the Pennsylvania Railroad Company into New York City crosses the "Turnpike" between Jersey City and Newark overhead, and at this point the transmission lines of the Public Service Corporation of New Jersey are at present carried over on wooden poles. This transmission line was fully described in the ELECTRICAL WORLD for Jan. 20, 1906. As the railway embankment at this point is about 25 ft. high, it became necessary to provide higher and more substantial supports for the wires than provided by the wooden poles in order to give ample clearance for passing trains.

The Pennsylvania Tunnel & Terminal Railroad Company, which is constructing the new railway, is erecting two steel towers for this purpose for the Public Service Corporation. A feature of the construction is the platform at the top to give the linemen a safe foothold while working on the wires and insulators.

The legs of the towers are bolted to concrete foundations, set 11 ft. below the surface with 2 ft. above. From the ground line to the top row of insulators the distance is 94 ft. 9 ins. At the base, the towers measure 9 ft. x 15 ft., the latter

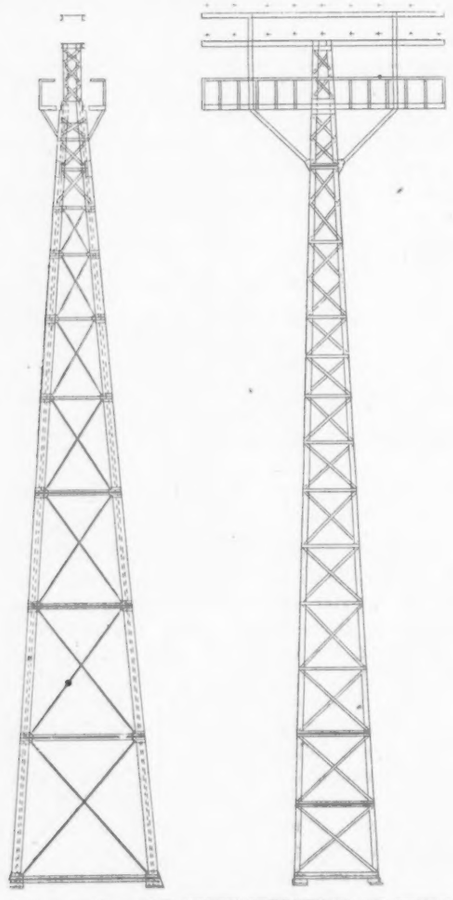


FIG. 1.—SIDE AND FRONT ELEVATIONS OF TOWER.

being the side dimension. The span between towers, from center to center, is 357 ft.

The platforms are of rod and bar construction, and are 26 ft. long by 7 ft. wide, the railings being 2 ft. 9 ins. high. Above the platform are two cross-arms, 26 ft. long by about 2 ft. wide, each carrying a double row of 9 insulators. The insulators are placed one behind the other, each couple forming an anchor insulator and practically eliminating all danger of wires breaking at the insulators, as shown in Fig. 2. The two cross-arms provide accommodation for 18 wires, but at the present time only 10 are in use, thus leaving ample room for future extensions. The height of the first row of insulators from the floor of the platform is 7 ft. 6 ins. and of the top row, 10 ft. 6 ins. This gives an abundance of room for wiremen to work with safety.

The insulators are placed longitudinally 3 ft. between centers, with the exception of the third insulator from each end, which is placed 3 ft. 6 ins. from the second. This variation permits of symmetrical spacing with reference to the upright supports of the cross-arms. These insulators were supplied by the R.

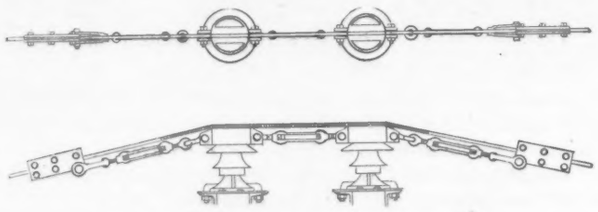


FIG. 2.—DIAGRAMS OF ANCHOR INSULATOR.

Thomas & Sons Company, East Liverpool, Ohio. They measure 6⅞ ins. across the umbrella and are 6 ins. high, each insulator having two petticoats. They were designed for a voltage of 25,000, but the present service pressure is 13,000 volts.

Mr. R. D. Coombs, structural engineer of electric traction for the Pennsylvania Tunnel & Terminal Railroad Company, designed the towers and the Archbold-Brady Company, Syracuse, N. Y., was the contractor for their construction and erection.

Mr. George Gibbs is chief engineer of electric traction for the railroad company, and Mr. Farley Osgood, general superintendent of distribution of the Public Service Corporation.

LETTER TO THE EDITORS.

Steam Consumption Tests of Turbine.

To the Editors of Electrical World:

SIRS:—Permit me to verify the statements made on page 895 of your issue for Nov. 2, in connection with a steam consumption test on a large turbine of the New York Edison Company. The accuracy of these results has been questioned by Mr. Chas. B. Burleigh, of Boston, in your Nov. 16 issue, in the following terms: "The above is undoubtedly a correct quotation of the statement, but the statement is not borne out by facts."

In this I have a two-fold object; first, to uphold the accuracy of your published report, and second, to correct a popular misconception regarding the comparison of turbine economies under different operating conditions.

It is questioned by Mr. Burleigh, that a water rate of 14.9 lbs. per kw-hour is superior to 12.5 lbs. per kw-hour, which he states was developed by an 8000-kw Curtis turbine operated by the Chicago Edison Company. In the first place, Mr. Burleigh has apparently established a new record for the Curtis type of turbine, as all previous published reports on this Chicago machine indicate a minimum consumption of 12.9 lbs. per kw-hour at a 10,000-kw load. Although the latter figure has recently been reported on a machine rated at 9000-kw, presumably it is the same machine Mr. Burleigh refers to. In the second place, I desire to emphasize the fact that economy tests are not comparable from either a technical or a commercial standpoint, unless respective operating conditions are known; so that it is manifestly improper to question the accuracy of your published report on such a superficial basis.

And herein, by the way, lies the greatest fallacy in the ceaseless struggle for high economies. Every engineer is, of course, deeply interested from a personal standpoint, in the attainment of the highest cyclical efficiency for all forms of prime movers; but high efficiency, in itself, means little from a commercial standpoint, unless the cost of attaining it is reckoned. This is apparently true of the extreme operating conditions assiduously cultivated in turbine operation. Unquestion-

ably, the results are spectacular; but, when we take into consideration the extra cost, maintenance and complexity of the additional auxiliary equipment and the losses incident thereto, our enthusiasm wanes, and we intuitively seek a lower plane where efficiency and cost form a more reasonable balance.

With this in view, I beg to submit that the 16 per cent difference between the economies noted by Mr. Burleigh does not exist. Apparently he has overlooked the premises in the original statement, which have been only partially quoted. The actual statement was, in substance:

"These consumption results, while not being less in actual steam consumption than the best results of European practice, yet are extremely good in view of the moderate operating conditions under which the test was conducted; in fact, they represent the best results that have yet been obtained by any turbine under the conditions named."

Taking both machines at their point of minimum consumption, the turbine tested by the New York Edison Company developed a water rate of approximately 15.1 lbs. per kw-hour for two consecutive hours, with an average pressure of 175 lbs., 97 deg. superheat, and 27.3 ins. of vacuum. Corrected to contract conditions, 175 lbs. pressure, 100 deg. superheat and 28 ins. vacuum, this is equivalent to 14.73 lbs. per kw-hour.

The turbine tested by the Chicago Edison Company developed a water rate of 12.9 lbs. per kw-hour, with 176 lbs. pressure, 147 deg. superheat and 29.5 ins. vacuum. Correcting to the above contract conditions by the percentages advocated by the builder of these machines, it is found that the equivalent water rate at the same load is 15.08 lbs. per kw-hour, a result which seems not to bear out Mr. Burleigh's contention. The results might be reduced still further—to a basis of dry saturated steam—and still be within the limits of your published statement regarding the record established by the New York Edison turbine, but I believe the above figures will be sufficient for the point in view.

In making comparisons such as these, which heretofore have seemed neither necessary nor opportune, I do so purely in the interest of a clear understanding of the situation, not for the purpose of drawing illusive conclusions, even though the latter may be quite tenable on careful analysis. In examining the performance of prime movers, we must not simply accept the rate of consumption of heat energy in the form of steam, gas, oil, etc., but make the comparison on a true scientific basis, else the results will quickly lead to erroneous conclusions. The sooner these principles are clearly understood and appreciated at their true value, the sooner will the apparently great disparity between turbine tests, such as those above outlined, be dispelled.

PITTSBURG, PA. J. R. BIBBINS.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Repulsion Motors.—K. SCHNETZLER.—A paper read before the German Association of Electrical Engineers on the regulation of repulsion motors by moving the brushes. The possibilities of this method, especially in the arrangement of Deri, are discussed, and it is found that between wide limits of torques and speeds all conditions are fulfilled which may be required from a satisfactory motor with regard to efficiency, power factor and commutation. The limitations of this method of regulation are investigated and some points of the construction of the motor are briefly discussed.—*Elek. Zeit.*, Nov. 14 and 21.

Lamps and Lighting.

Arc Lamp.—An illustrated description of an arc lamp of English make which has some new features. The simplicity of the mechanism is indicated by the total absence of a shunt coil, the regulation of the feed being controlled entirely by the series solenoid. The construction is shown in Fig. 1, where *A* is a dash-pot, *B* the series solenoid with plunger *C*, *E* a rocker, *F* a clutch link, *G* and *J* the bottom and top carbon holders respectively, *H* center rods, *K* a flexible conductor, *L* the negative lead and *O* the negative rod. The pull of the solenoid *B* is counterbalanced by the weight *M*, and is also regulated by the spring in the dash-pot *A*, which increases the pull of the soleniod upon its core and equalizes the increased sensitiveness of the current variations. There is a special feature in these lamps, which comprises a regulating clutch which is directly connected to the lever arm of the balance weight. This clutch *N* is of the usual washer type, acting directly on the carbon, and regulated by the motion of the rocking arm of the balance weight *M*, which takes the place of an air dash-pot, which is the usual feature of other lamps of this type. By this means the uniformity of the arc is assured, and the steadiness and regular feeding of both electrodes is regulated with a consumption of 550 watts. The lamp takes from 2½ to 5 amperes of current, and can be used singly on voltages from 200 to 230.—Lond. *Elec. Eng'ing*, Nov. 14.

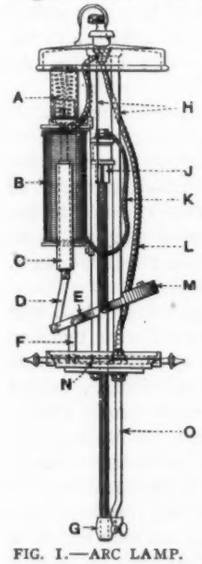


FIG. 1.—ARC LAMP.

Low-Pressure Mercury-Vapor Lamp for Strong Currents.—J. E. LILIENFELD.—A description of a new lamp of this type. The use of the mercury lamp with strong currents is subject to the difficulty that the mercury is extensively evaporated, and the pressure of the mercury vapor is increased beyond the most favorable point. For any given current density there is a certain low pressure at which the amount of luminous radiation is in the largest ratio to the heat radiation. If the current density is increased, the pressure increases at a higher rate, and soon becomes too great for the optimum. This disadvantage is avoided by the lamp of the author, who divides the vacuum tube midway by a stopper having a narrow channel, which leads into a narrow tube opening just above the other mercury electrode. The two halves of the vacuum tube on each side of the stopper can be taken apart. The inner narrow glass tube has the effect of concentrating the current, and thus keeping pace with the vapor density. The diameters of the outer and inner tube can be adjusted beforehand so as to have the optimum effect for any given current density.—*Phys. Zeit.*, Oct. 24; abstracted in Lond. *Elec. Eng'ing*, Nov. 14.

Sealing-in Wires.—A note on a recent British patent of Bastian and Calvert for a method of sealing electric conductors in or through glass. Specially-shaped metallic conductors of minimum sectional area consistent with the required current-density are employed. "An important part of this invention is the method of coating the conductor at the portion where it is to be sealed into the glass, a small tube or envelope of enamel glass being applied to the conductor before sealing the conductor into the glass. The conductor is formed from a thin strip of foil, over which is slipped a small tube of flux. The flux is then heated rapidly in a flame and is melted on to the conductor, thus preventing oxidation of the conductor. These coated conductors are then melted into ordinary glass in the usual manner."—Lond. *Elec. Eng'ing*, Nov. 14.

Tungsten.—The export of tungsten from Portugal has increased from 9 tons in 1905 to 336 tons in 1906. This is thought to be due chiefly to the development of the tungsten lamp. The increased use of ferro-tungsten may also have had an effect.—Lond. *Elec. Eng'ing*, Nov. 14.

Power.

Steam Turbines and Gas Engines.—E. J. Fox.—A further contribution to his controversy with Andrews on the comparative cost of large steam-turbine and gas-engine plants. In the case of a 16,000-kw plant he estimates a capital expenditure of $861,060 for a steam-turbine plant and of $2,014,160 for a gas-engine plant with 50 per cent reserve plant. "It remains for those installing a plant to decide for themselves whether the low fuel charges accompanying the use of gas engines—and after making due allowance for the increased cost of running gas engines in other respects—will justify the big difference in capital expenditure. It seems that the extreme ease with which overloads can be dealt with on steam turbines is sometimes overlooked, in view of the fact that the overload range is frequently used for dealing with the peaks of loads without a special plant being installed for the purpose, and also obviating the necessity for installing further reserve plant."—Lond. *Elec. Eng'ing*, Nov. 14.

French Water-Power Plants.—H. Armagnat.—An article, with map, on the electric power stations on the Mediterranean Sea coast of France. The development began in 1897, and there are now 11 hydroelectric stations with an aggregate rating of 61,500 kilowatts. For reserve, nine steam plants, having a total of 21,150 kilowatts, are provided. In operation the plants are not connected in parallel; each supplies energy to a distinct area, but it is possible to interchange energy between the different plants.—*L'Industrie Elec.*, Nov. 10.

Sweden.—M. J. Heilmann.—An article on the water-powers available in Sweden. A list of 17 water-powers is given with an aggregate power of 570,000 kilowatts, which figure is increased to 585,0000 kilowatts by the addition of secondary auxiliary plants.—*L'Industrie Elec.*, Nov. 10.

Traction.

High Speed of Electric Locomotives on Grades.—A. H. Armstrong.—A communication discussing the question whether in view of the desirability of uniformity in station load high-speed up grades is worth the while for freight haulage. The writer emphasizes that the generating station of electrically-operated railroads occupies the position of an auxiliary and must conform in its practice and economy to the demands of the operating department, which latter are paramount. Electrification of steam roads is not attractive either financially or otherwise, if the electric locomotive is called upon simply to duplicate the present performance of the steam locomotives. It is largely in connection with increased speed that the supporters of electrification hope to make a showing sufficient to warrant the expense. The introduction of the electric locomotive not only gives the operating department a means of quickening the passage of freight and passenger trains over heavy grade divisions with resulting reduction in operating expenses, but it also permits an increase in the tonnage over congested track sections by reason of the increased speed.—*St. R'y Jour.*, Nov. 23.

Lötschberg Railroad.—S. Herzog.—An article on this road which will be the first European main railroad in the design of which electric operation is taken into consideration. The road is a connecting link between the railroad systems of different countries so that express trains of 300 tons and freight trains of 600 tons will run on it. Electric locomotives will, of course, be used. The electrical energy will be supplied at the northern end from the Kander and Hagneck generating plants and at the southern end from the Lonza Works. No decision has yet been reached concerning the electric system to be used. Although the first cost will be higher for electric than for steam operation, the operating cost will be lower, and for the traffic to be expected the total cost, including interest and amortization, will be lower for the electrical system. Notes are given on the use of electric energy in building the tunnels.—*Elek. u. Masch.*, Oct. 27.

London.—H. M. Sayers.—A critical analysis of last year's account of the London County Council's Tramways. The progress of the electric equipment made a rapid stride during the year, at the cost of much disturbance to traffic on the northern lines, shown by a large falling off in the receipts. The extension of electric traction to about half the mileage operated, and the supply of energy from the Greenwich station during the greater part of the year, permit, for the first time, of a useful analysis of the returns from which some forecast of the results of working the whole of the lines electrically is possible. It is shown that, on the average mileage operated, the gross receipts are over $100,000, and the net over $40,000 per route-mile; and that there is a fair net profit after paying all capital charges and providing 2 cents per car-mile for the renewal reserves fund. Examination of the working expenses in detail shows that while certain items are high, compared with the average figures on other tramways, the special circumstances, including the use of the conduit system, afford a reasonable explanation, and also a prospect of a material reduction as the system expands and the conditions become more settled. The high rate of earning per route-mile and per car-mile, on account of high traffic density, quite compensate for the higher expenditure. The average total annual receipts per route-mile were $103,655 and are probably the best in the world. The statistics show that unusually high rate of average speed (8½ miles per hour) and car mileage per day (106 miles per day per car) are maintained. The question of the extra capital and working costs of the conduit system is briefly examined in relation to the receipts, and it is shown that for the lines in operation, the density of the traffic covers the cost of the luxury, but that a less expensive equipment will be needed to make outlying extensions remunerative.—Lond. *Elec. Eng'ing*, Nov. 14.

Rail Corrugation.—An elaborate illustrated report presented before the German Street and Interurban Railway Association. It is based on extended experiments with dummy wheels and rails of different degrees of hardness, and the conclusion is reached that corrugation arises when the strains on the track approach or equal the elastic limit of the rail. It is also stated that corrugation cannot be ascribed to the usual slight differences in material due to imperfect rolling.—*St. R'y Jour.*, Nov. 9.

Braking.—F. Heckler.—A paper on foundation brake-gear design for electric railway cars. The author discusses the importance of braking and presents several combinations of trucks and brake rigging, with comments on their relative value.—*St. R'y Jour.*, Nov. 30.

Installations, Systems and Appliances.

Three-phase Energy Transmission Without Switchgear.—R. C. Roberts.—For plants employing underground cables for transmitting energy to motor-generator sub-stations, the author recommends the employment of equal-sized units in generating station and sub-station, permanently connected together respectively on separate circuits without parallel running. This method results in the elimination of switchgear, in the elimination of the difficulties of charging up feeders and switching on large high-tension motors, in the elimination of synchronizing and in the simplicity of the automatic protective devices. The author thinks, however, that the chief advantage would be the enhanced reliability of supply ensuing from a complete isolation of each unit of high-tension transmission.—Lond. *Elec. Eng'ing*, Nov. 14.

Lightning Arresters.—J. Liska.—An article in which the author discusses the principles on which the Wurts cylinder lightning arrester operates. To speak of non-arcing metals is not sufficient. Steinmetz has already called attention to the influence of the capacity of the cylinders with respect to one another and to earth. On this basis the author considers the distribution of the potential along the arrester and gives a simple equation for it. He suggests the adjustment of the capacity between cylinders and earth on the basis of his formula, and gives a few notes on the design of such arresters with adjustable capacity.—*Elek. u. Masch.*, Oct. 27.

Motor-Switch and Fuse-Box.—An illustrated description of a combined motor-switch and fuse-box, of English make, designed on the principle that it cannot be opened unless the switch is in the off position.—Lond. *Elec. Eng'ing*, Nov. 14.

Wires, Wiring and Conduits.

Grading of Cables.—A. RUSSELL.—A paper read before the (British) Institute of Electrical Engineers on the dielectric strength of insulating materials and the grading of cables, commented on in our issue last week. It is not safe to conclude that a disruptive discharge ensues the moment the maximum electric stress at any point of the dielectric between the two electrodes attains the breaking-down value for that dielectric. The breaking down of a portion of the dielectric may relieve the electric stress on the remainder. A disruptive discharge ensues only when the breaking down of part of the material leads to the electric stress on the remaining part being greater than it can withstand. The easiest way of finding the dielectric strength of insulating materials is by finding the disruptive voltage between two equal spherical electrodes embedded in the material. The electrodes should not be too near together. When a maximum inaccuracy of more than 1 per cent is not permissible, they should be at least one-half centimeter apart. Under normal conditions the dielectric strength of air, determined in this way, is about 3800 volts per millimeter. Of other gases, helium has an extraordinarily high dielectric strength, more than eight times that of air. The dielectric strength of oils can be found by the same method with a distance between the spherical electrodes greater than 0.3 centimeter; at this distance 40,000 to 50,000 volts will be required to break down good insulating oils. In order to find the true dielectric strength of an oil, it is necessary to dry it thoroughly before the test. This is best done by bubbling hot air through it, but it is not advisable to heat the oil above 100 deg. C. In case of isotropic solids as insulating materials, the same method as for gases and liquids may be employed, provided the test electrodes can be entirely embedded in the material. The method frequently adopted of putting thin sheets of the insulating material between metal electrodes in air is of doubtful value; as the voltage is increased, the air surrounding the electrodes breaks down long before the disruptive voltage is reached. High-pressure concentric cables, having an isotropic dielectric, for a maximum working pressure V should be constructed so that $b = a\,\epsilon^{d/a}$, where V/d is the maximum permissible working stress to which the dielectric may be subjected, b is the inner radius of the outer conductor and a is the outer radius of the inner conductor. ϵ is the base of Naperian logarithms. The smallest permissible value of a is d. When the core is stranded, it should be encased in a thin lead tube. The effect of the temperature gradient in the dielectric of a concentric main when working, is often to make the electric stress between the two conductors more uniform. Jona's experiments indicate that the dielectric strengths of paper-insulated cables do not vary much when the range of temperature does not exceed 60 deg. C. They are probably slightly less at the high temperatures. Skinner's experiments on glass, treated cloth, mica, etc., show that the dielectric strengths of many insulating materials in the solid form diminish as the temperature rises. With a composite dielectric subjected to alternating pressures, the potential differences across the layers are usually out of phase with one another. It is only in a limited number of cases, however, that the increase of the stress due to this cause has to be considered, as the leakage currents are usually negligibly small in comparison with the capacity currents. The effects of alternating and continuous pressures in producing stresses in the dielectric are sometimes quite different. High-pressure cables for alternating and direct-current circuits should be graded so as to make the maximum electric stress on the dielectric as small as possible, and stranded conductors should be encased in thin lead tubes.—Lond. *Elec.*, Nov. 15.

High-Tension Insulators Near the Sea.—A note on some observations made by M. G. Anfossi on a 25,000-volt line at Genoa near the sea. Leakage and interruptions of the service frequently occur and are considered to be due to the deposit of a mixture of salt and dust on the lower part of the insulators which are protected from wind and rain. This deposit is hydroscopic and increases in time. No similar effects have been observed on the 5000 and 10,000-volt lines, so that the ordinary insulators would appear to be sufficient for the same. The author proposes to overcome the difficulty by using an insulator with as small an interior surface as possible, while the surface exposed to the rain is increased. The new type consists of a grooved stem carrying a very flat bell; the caking of salt is then easily removed by the wind and rain.—Lond. *Elec.*, Nov. 15.

Electrophysics and Magnetism.

Resistance of Coils for High Frequencies.—A. SOMMERFELD.—A. Battelli had formerly found a strong increase of the resistance of coils with the frequency and had developed a theory which he considered to be in good agreement with the results of his measurements, while they were said to be in contradiction with a formula of the present author. The latter now maintains that his own formula is correct and that the apparent agreement between Battelli's theory and results is due to a mistake in the calculations. The same issue contains a further paper by Battelli on the same subject.—*Phys. Zeit.*, Nov. 1.

Internal Temperature Gradient of Metals.—S. B. SERVISS.—Thwing has formerly found that cylinders of common materials showed at points 3 centimeters from their surfaces an excess of temperature above their surroundings, which he ascribed to their radioactivity. This has been doubted and the investigation of the present author, who repeated Thwing's experiments with some modifications in the apparatus, gave negative results. —*Am. Jour. Science*, December.

Electrochemistry and Batteries.

Storage Battery Electrode.—A note on a recent British patent of H. F. Joel, the object of which is to provide strong circulation of the electrolyte over the surface of the plates during charging. For this purpose the electrodes are provided with slightly projecting ribs, rather inclined from the horizontal, and in the grooves thus formed he places his insulators, of flat material, which rest between the electrodes, forming a duct, whereby the electrolyte is caused by the gases which are set free, to circulate over the faces of the plates.—Lond. *Elec. Eng'ing*, Nov. 14.

Units, Measurements and Instruments.

Electric Thermometer.—G. A. SCHULTZE.—A description of an electric resistance thermometer based on the following principle proposed by Koepsel and indicated in Fig. 2. The

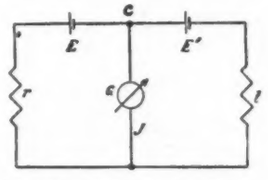


FIG. 2.—DIAGRAM OF ELECTRIC THERMOMETER CIRCUITS.

two equal and constant sources of current E and E' are in series with a constant resistance r and a variable resistance t. The bridge contains the galvanometer G. The current J through the galvanometer is zero, if r and t are equal. Otherwise the current J indicates directly the difference between t and r or between their temperatures, if both resistances are otherwise identical.—*Elek. Anz.*, Sept. 22; abstracted in *Elek. u. Masch.*, Nov. 10.

Speed Meters for Automobiles.—W. VON MOLO.—A discussion, with diagrams, of a number of commercial electric speed meters, all of which are based on the principle that a revolving magnet system acts on a disc and as a result of the eddy currents produced the disc is set in rotation which is counteracted by a spring.—*Elek. u. Masch.*, Nov. 11.

Water Resistances for Tests.—C. RICHTER.—For testing large electrical machines water resistors have various advantages. The author shows in detail how to calculate the quantity of water required, the speed of the running water, the size of, and the distance between, the electrodes, etc. Numerous formulas, tables and diagrams are given.—*Elek. u. Masch.*, Nov. 17.

Batteries for Testing Mains.—K. Edgcumbe.—A note calling attention to the surface leakage of the battery, especially in the case of dry cells. With an ordinary 200-volt dry battery the insulation after one month's use will probably be of the order of 0.1 megohm, which means a loss of some 10 ampere-hours in about six months. The remedy is to divide the cells into groups of, say, 25 volts each, which groups, although all mounted in one box, are kept quite distinct, and are only joined up in series when actually required for use. The ampere-hours lost are thereby reduced to about one-tenth of their former value.—Lond. *Elec. Eng'ing,* Nov. 14.

Telegraphy, Telephony and Signals.

British Telephone Exchange.—An illustrated description of a new telephone exchange recently opened in Hornsey. It is equipped for 2700 subscribers and has an ultimate capacity of 5400. It is on the full common battery system. There are 43 outgoing and 47 incoming junctions, worked on the order-wire system, and 10 outgoing and 10 incoming ringing junctions. The switchboards are arranged for two-party ringing with a two-party master ringing key on the subscribers' board, and separate keys on the junction board. There is a modification of the usual design of the main distributing frame. The cables enter on the horizontal side, through fuses placed on large porcelain fuse strips, and the heat coils are on the vertical side. —Lond. *Elec. Eng'ing,* Nov. 14.

Cable Telegraphy.—A note on a recent British patent of S. G. Brown for accelerating the speed of transmission in submarine telegraphy. "This is done by utilizing not only the quick-changing currents, but also the slow discharge currents, as used in the present mode of signaling, and using them at a speed much beyond that of any of the present systems. The automatic transmitter operated by a sending battery, the transmitter being constructed so that the battery current may be applied as much as possible for the whole signaling period. The receiver being a relay having the moving signaling parts constructed as light as possible for the work to be performed, the relay is able to translate and record the message by value of the total incoming current at any instant."—Lond. *Elec. Eng'ing,* Nov. 14.

Hungary.—Statistical notes on telegraphy and telephony in Hungary in 1906. The total length of telegraph lines was 130,958 kilometers and that of telephone lines 213,559 kilometers. The total number of telegrams was 10,017,452, an increase of 5 per cent over 1905. The total number of telephone conversations was 104,023,110, an increase of 25 per cent over 1905.—*Elek. u. Masch.,* Nov. 3.

Miscellaneous.

Electrical Engineering.—F. Niethammer.—A lecture of a general nature on the development of the electrical industries in their various branches.—*Elek. u. Masch.,* Nov. 3.

BOOK REVIEWS.

Trattato Di Telefonia. By I. Brunelli and E. Longo. In 12 parts. 600 pages, 300 illus. Rome: G. Scotti & Company. Price, each part, 1.25 lire.

The authors have sought to present a treatise on telephony which should be both scientifically reliable and practically useful to telephonists. The work is divided into seven parts, following a historical introduction: I. The telephonic apparatus; II. Telephonic lines; III. City service; IV. Interurban service; V. Special questions; VI. The installation and operation of modern telephone stations; VII. Tariffs. The treatment is simple, employing plenty of illustrations and simple algebra in the mathematical demonstrations. The book will be of interest to students of telephony in Europe, and particularly to students of the development of Italian telephony.

Electrical Engineers' Central-Station Directory. London: Biggs & Co. 592 pages.

The main title of this useful directory, published from the office of the *Electrical Engineer,* is a misnomer insofar as it ignores electric railways, to which subject more than 100 pages are devoted. In addition, isolated plants occupy about 50 pages, and a list of electrical engineers is included. Owing to Board of Trade requirements, British lighting and railway plants are required to give publicity to their capital, operating and trading accounts, and consequently the directory is enabled to publish much fuller data than would be obtainable in this country, if we except the case of the Massachusetts central stations, of which similar publicity is required. The entry for each central includes full plant data, rates in detail, number of men employed, and financial and operating data for the current and several preceding years. The final pages of the book contain a list of stations in British possessions, of which, however, the data are much fewer than in the main section. Whoever has need for information concerning the British central-station and electric traction industries will find this volume a valuable compendium.

Alternating-Current Motors. By A. S. McAllister, Ph. D. New York: McGraw Publishing Company. 291 pages, 126 illustrations. Price, $3.

This excellent treatise has reached its second edition within a year from the publication of the first. While this fact alone is evidence of the quality and character of the work, we cannot refrain from commenting at greater length upon some valuable additions which have been made in the second edition, which will prove this work of interest also to those who have studied the book when it first came out. On page 15 the author discusses the advantages derived from employing equivalent single-phase quantities in connection with polyphase circuits. A consistent use of such equivalent single-phase quantities would appear to be of advantage, although we believe that the author overestimates the importance of such convention. In general, it would appear best, and surely freest from ambiguity, to speak of the resistance of the phases between neutral and terminal, etc., rather than of the equivalent single-phase resistance. The suggestion, however, is very excellent and it well deserves being carefully borne in mind. In the fourth chapter, on frequency-converters, there is much that is new and of considerable interest concerning motor-converters, and, while the practical application of these machines is not very great as yet, the study of their characteristics is extremely interesting and instructive.

The treatment of the single-phase commutator motors is one of the finest contributions to the theory of these machines. Clear, concise and lucid, it forms one of the most instructive chapters of the book. The appendix contains a chapter on "The Leakage Reactance of Induction Motors," which is a most readable account, and a supplement is given with the work entitled "Circular Current Loci and V-Curves of the Synchronous Motor," which is an excellent exposition of the phenomena of synchronous motors in a remarkably perspicuous manner.

The book represents one of the finest contributions to electrical literature of recent years. The author's exceptional ability and clearness of presentation make this book fascinating reading even to those who are familiar with the subject, and no one can lay it aside without bestowing a large meed of admiration on the author for having written a book altogether extraordinary and showing the marks of exceptional talent.

Konstruktion und Schaltungen aus dem Gebiete der Elektrischen Bohnen. By O. S. Bragstad. Berlin: Julius Springer. 31 plates in portfolio, with 58 pages of explanatory text in pamphlet form.

This series of plates by Professor Bragstad, of the Karlsruhe Hochschule Friderciana, will be found of value by electric railway engineers and electricians, as well as by students and others interested in the technical side of electric traction. Four sheets of drawings with accompanying characteristic curves, of four types of railway motors are followed by a similar number of sheets of time-curves of Westinghouse motors. Then come 28 sheets of diagrams of controller and motor connections covering direct-current, single-phase and

three-phase equipments. All of the diagrams, which are very satisfactory, are based upon the same scheme of representation. The three final sheets show respectively, details of the overhead construction of the Simplon tunnel line, various types of third-rail construction, and details of the Westinghouse brake valve. The pamphlet accompanying the portfolio contains explanatory matter relating to each plate.

MESSUNGEN AN ELEKTRISCHEN MASCHINEN. By Rudolf Krause. Berlin: Julius Springer. 193 pages, 178 illustrations. Price, 5 marks.

This excellently illustrated little text-book gives a very full account of the ordinary testing instruments and their application to the testing of the more usual types of dynamo-electric machinery. The book is divided into nine chapters, as follows: Chapter I, instruments and their connections; II, measurements of electric power; III, resistance and conductance; IV, speed frequency and slip; V, insulation of machines; VI, magnetic flux and wave form; VII, load torque and power of machines; VIII, losses in machines; IX, standard types of report on machine tests. The book is clearly written from the standpoint of the testing engineer. It will be of value to all students of electric machinery, and evidently represents the most recent German practice in the testing of such machinery.

TRANSFORMATOREN FUR WECHSELSTROM UND DREHSTROM. (Transformers for Single-phase and Polyphase Service.) By Gisbert Kapp. Third edition, revised and enlarged. Berlin: Julius Springer. 326 pages, 185 illustrations. Price, 8 marks.

The third edition of Prof. Kapp's book on transformers shows a marked revision and enlargement over the preceding editions and the development of the subject has been brought up to date. The treatment of the subject is from the standpoints of the designer and of the operating engineer, as well as of the student. The volume is well adapted to text-book purposes in teaching. The mathematics are not elementary in character, nor are they beyond the reach of the properly equipped student of engineering. The descriptive matter is essentially clear and thorough. The book will be of particular value to students of electrical engineering.

ELECTRIC RAILWAY ENGINEERING. By H. F. Parshall and H. M. Hobart. New York: D. Van Nostrand Company. 475 pages, 437 illustrations, 123 tables. Price, $10.

This volume, which has been prepared for covering the whole field of electric railway engineering, is divided into three parts dealing, respectively, with the mechanics of electric traction, the generation and transmission of electrical energy, and the rolling stock.

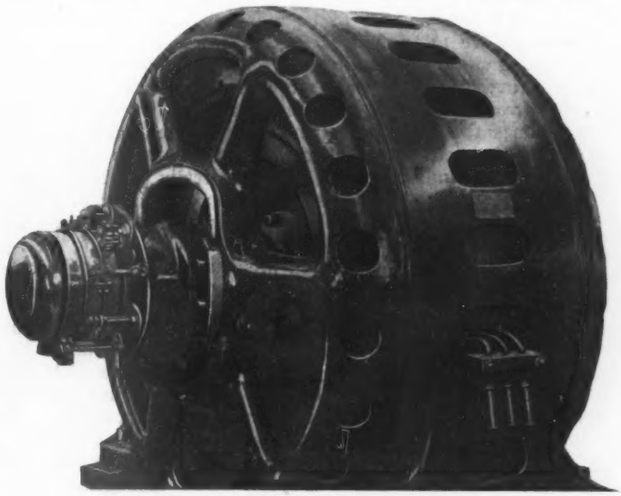
Part I contains a thorough analysis of the power and energy required for propulsion and the characteristics of motors that may be used for supplying the tractive force. In Part II much reliable information is given concerning generating equipments, the transmission system, sub-stations and distribution systems. The portion of the book which touches upon subjects of particular interest at the present time is Part III, in which the authors discuss the relative merits of direct and alternating-current equipments for train propulsion. The attitude of the authors is well expressed in the following sentences: "Half the sum spent in developing the single-phase commutator motor to its present condition (in which it still remains less efficient, more bulky, and less satisfactory in several respects than the 600-volt continuous-current motor) will result in the development of thoroughly satisfactory high-tension continuous-current motors. These motors will be as efficient and as light for a given temperature rating and a given speed as the present standard 600-volt motors. The commutation will be better. While the development of each class of machine has advanced beyond the point that could reasonably have been foreseen, and while, in our judgment, it is impossible at the present time to predict where the limitations will be reached, we are satisfied that a careful comparison of the two types at the present time is decidedly to the advantage of the high-tension, continuous-current motor." The boldness of the authors in making such a statement will be appreciated when it is known that their conclusions as to the operation of single-phase commutator motors seem to have been based largely on the results obtained with certain early experimental motors; the book contains no description of the 25-cycle locomotives now in successful use on the New Haven Railroad, or of the 15-cycle locomotive recently constructed for the Pennsylvania Railroad. Moreover, the most excellent operating characteristics of the commutating-pole type of direct-current railway motor are given merely an incidental mention, and the discussion is expressed in the future tense.

The book is a storehouse of carefully selected and well arranged information of value to the electrical railway engineer.

Induction Motors for Copper and Brass Rolling Mills.

The new plant of the Buffalo Copper & Brass Rolling Mills at Black Rock Station will be driven by means of induction motors supplied with energy transmitted from Niagara. For driving the rolls, three Allis-Chalmers motors will be used, one rated at 500 horse-power for the main rolls and two at 250 horse-power for the finishing rolls. All three motors are of the wound-rotor type designed to operate at 25 cycles, 2300 volts; the 500-hp motor runs at 375 r. p. m. synchronous speed, and the 230-hp at 500 r. p. m. The motors are connected to the rolls by means of flexible couplings.

The accompanying illustration shows the 500-hp motor; the two 250-hp machines are of exactly similar design. The construction throughout is very substantial and suited to the exacting requirements of rolling mill work. The stator coils are placed in open slots and held in place by wedges so that they can be readily removed. The stator core is provided with



SLIP-RING, 500-HP INDUCTION MOTOR.

numerous ventilating ducts to allow circulation of air through the core and windings. The end connections of the stator coils are securely held where they project beyond the core.

The rotor is provided with a three-phase, Y-connected winding joined to three cast-copper collector rings mounted on the shaft. The rings are outside the bearing housing so as to be readily accessible, the leads from the winding being brought through a hole in the shaft.

The rotor winding is made up of copper strip having the conductors in the slots joined at the ends by involute end connections securely held in place by brass shields. The whole rotor construction is such as to give thorough ventilation of all parts.

Each motor is provided with a cast secondary starting resistor with an oil-immersed controlling switch for cutting the resistance out of circuit and gradually bringing the motor up to speed. A small part of this resistor is designed for continuous service, and can be left in circuit.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Further improvement in the financial situation is facilitating the return to normal commercial conditions, but there is still a good deal of idle machinery at mills and factories. In the leading industries a disposition is shown to defer production until there is no probability of accumulation, and consumers show an inclination to place orders for future deliveries. At best, however, trade as a whole is still very quiet and industrial activity is below the normal for this season of the year. Collections are still very backward, although a slight improvement was shown. More interest was evinced by buyers of pig iron for future delivery; prices, however, are lower, and production is still being curtailed. It appears that most of the furnaces in the Mahoning and Shenango regions will be out of blast by the middle of this month. The output in November declined 23 per cent from that of October, but this ratio does not begin to represent the curtailment thus far in December. Some steel plants have resumed operations, but others have discontinued and wages are being reduced. No new business is being done yet in steel rails, but it is understood that the railways will soon come into the market for large tonnages. Structural material was in moderate demand. The lumber and allied trades were rather dull. Railways earnings for November were 2 per cent less than in November, 1906. Foreign commerce at the Port of New York for the week shows a gain of $4,526,856 in exports and a loss of $383,049 in imports as compared with the corresponding week last year. Copper remains inactive, but prices are no lower, although the undertone does not appear to be so firm, and the European interests seem to be more anxious to force sales. Quotations are 13½c. for lake, 13¼c. for electrolytic and 13c. for casting stock. According to *Bradstreet's*, the business failures during November were more numerous than in October or in November of last year, and liabilities were more than three times those of November last year, but only one-fifth those of October, because bank suspensions were fewer and less important, indicating that the crisis really passed in October. There were 1108 failures in November, an increase of 14.2 per cent over October and of 36.8 per cent over November last year. The number of failures during the week ending Dec. 5 was 272, against 258 in the week previous, and 216 in the corresponding week last year.

CHICAGO TELEPHONE RATES.—It would appear by advices from Chicago that as a result of the extension of the franchise recently granted by a new ordinance, the Chicago Telephone Company must spend large sums in readjustment and extension of the plant. The old ordinance does not expire until January, 1909, but the annual report for the year ending Dec. 31, 1907, will show considerable in the way of concessions granted at various times this year. The management has formally accepted the 20-year extension of its franchise and is now putting the reduced schedules into effect. A further concession has been announced to the 80,000 subscribers to the slot machines. The ordinance provides that the excesses or deficits therein at the end of one month may be balanced by the collections of the subsequent months, and the company has made this arrangement effective for November in advance of the beginning of the new ordinance. Abolition of toll charges within the city limits has taken effect, as has the 5-cent rate between neighborhood exchanges. Dime telephones in the down-town district have been replaced by nickel instruments. The city has become a sort of partner of the company. President Wheeler says: "All bills will be made out from Dec. 1 at the new rates for the grade of service which the subscriber is now getting. Thus every subscriber will be offered a reduction in rates." It is optional with a subscriber to call for a better grade of service at the old rate, or to avail himself directly of the reduced rates. This involves many immediate mechanical changes, as the prevailing tendency is to get the better service available. Chicago's druggists, the hotels, and other places where public telephones are installed and which have received a share of the receipts, will in the future get nothing, and the telephone company everything. Under the old arrangement, after a certain guaranteed amount had been put in the coin-box by the patrons of drug stores, the remainder was divided between the druggist and the company. But there is a clause in a new telephone ordinance which provides that the company shall furnish telephones "without discrimination, and at the same rates" to all persons electing to take any class or kind of service. Assistant Corporation Counsel Miller, to whom the question was referred, has decided that inasmuch as all these public telephones are in the class of the nickel-in-the-slot measured rate instruments, the company must charge the same for them as for residence telephones used only by one subscriber.

STANLEY ELECTRIC WORKS.—According to latest reports from Pittsfield, Mass., First Vice-President Cummings C. Chesney, of the Stanley G—I Electric Manufacturing Company, has stated that matters have so adjusted themselves at the plant that it will be possible to swing through the winter with practically the entire operating force of 2100 employees. Had it not been for the disturbances in the financial world, the force would have been increased to 3000 early next year. As it is, it is felt that if present hands are retained the concern will be doing its part in the scheme of co-operation among employers and employed that is urged so earnestly everywhere just now. As a matter of fact there are only three or four out of 15 or 16 departments that are not working on full time, and these exceptions are governed by purely normal conditions. In some instances the departments have overmanufactured; that is to say, they have secured such a lead over the others that they must of necessity wait until those others catch up. "We are running," said Mr. Chesney, "pretty close to the entire capacity of the plant, which is doing very well, all things considered. We cannot hope to expand to any great extent until a change comes over the financial world, but we hope to swing through the winter with practically our present force." With 2100 employees and a payroll of $27,000 every week, the Stanley is one of the big factors in the industrial life of Pittsfield, and that the management is facing the long winter so hopefully will be good news to the community.

GENERAL ELECTRIC EMPLOYEES.—An unauthorized statement to the effect that the General Electric Company was to dispense with the services of 7,500 men last Saturday was positively and emphatically denied by President Coffin, of the company. He said: "Such a proposition was not even suggested. We have more men at actual employment to-day at both our Schenectady and Lynn works than we had two years ago. Of course, gradual decreases are suggested at times, but we certainly would not disorganize our large and efficient force by such wholesale reductions as the unauthorized statement makes it appear. Rather than reduce our force at all I would much prefer to see all our men employed, even though they were required to reduce their working time to four or five days each week." This states the case succinctly and exactly, and this is why President Coffin always stands conspicuous in fair treatment of labor.

CLARK ON COPPER.—In an interview at Salt Lake City last week, Senator W. A. Clark said: "The total reduction in the output of copper is so large that six months ought to see the surplus eliminated entirely. When that is done, I expect to see copper go back to about 16 cents a pound, and that is enough. At that figure consumption is possible on a large scale, and, while it will not permit all the mines to resume on the old basis, it will still furnish employment for a large proportion of the men who have been thrown out of employment by the recent slump."

ELECTRICITY IN INDIA.—Kilburn & Company, of Calcutta, have been granted a license by the British-India Government for the supply of energy for electric traction and for the general supply of electrical energy to the public, including particular consumers under special agreements in respect of the cantonment of Jubulpore in the Central Provinces.

THE McCALL'S FERRY POWER.—The first official announcement of the causes which led to the discontinuance of operations on the big power dam at McCall's Ferry has just been made from the office of the power company in New York City. In a letter to the executive committee of the board of directors, President Dimock states that the company had no funds on deposit in the Knickerbocker Trust Company and consequently lost none, and that when conditions are such as to enable the enterprise to make suitable financial arrangements the work on the dam will be rushed to completion. President Dimock's letter is accompanied by one from Chief Engineer Dr. Cary T. Hutchinson, in which the latter says that the suspension occurred at a particularly favorable time and that the danger from winter floods is practically negligible. Dr. Hutchinson estimates that the work on the dam and power house is 80 per cent finished. The plans of the company provide for the construction of a dam 2530 ft. long and a power house 500 ft. long, to contain ten turbines, each of 13,000 hp, making the total rated output of the power house 135,000 hp; this power house, with the generators, transformers and other electrical apparatus make together a plant having a capacity to deliver to Baltimore or Philadelphia 100,000 hp with nine units in service, leaving the tenth unit as a reserve. This enlarged plan gives a salable output double that of the original plan, and ensures net earnings more than double of the original plan.

MOTORS FOR GRINDING SHOPS.—Deer & Company, Moline, Ill., one of the largest manufacturers of plow and agricultural implements in the world, recently purchased a number of 20-hp and 30-hp, 60-cycle, 3-phase, 440-volt Allis-Chalmers induction motors, which are intended for use in the grinding shop where the mold boards, shares and other plow parts are ground. The service to which these motors are to be applied is intermittent in character, and the application itself is something out of the ordinary. Each motor is arranged for a pulley on either end of the shaft, but the pulleys are left off and the shaft extended by coupling to it a piece of shaft about six feet long carrying pulley and having extra bearings. From each pulley is belted a grinding machine, each machine having two emery or carborundum wheels, as desired, for the special type of steel to be ground, making a total of four grinding wheels to each motor, allowing four men the service of one motor, which gives a group-drive effect. The pieces of steel to be ground are laid on the frame, and the operator presses the steel against the wheel by lifting the frame up so that the desired part of the steel can be ground. Thus there is a possibility of four men grinding simultaneously, but rarely more than two wheels are working at once because of time consumed in shifting the steel pieces on the frame so as to get them in position to be ground.

ORDERS FOR RELIANCE ENGINES.—The Allis-Chalmers Company reports several large orders for its Reliance Corliss engines and generator sets. The Lodge & Shipley Machine Tool Company, of Cincinnati, Ohio, has purchased one of these sets, comprising an 18 in. x 36 in. "Reliance" engine, direct coupled to a 200-kw, 240-volt, engine-type generator. The unit will be used for lighting and power service. Other sales of "Reliance" sets recently made are as follows: W. J. Rainey, Connellsville, Pa., a 20 in. x 36 in. engine, direct coupled to a 250-kw, engine-type, direct-current generator; The Jeanerette electric light plant, of Jeanerette, La., one 14 in. x 24 in. engine direct coupled to a 100-kw, engine-type, direct-current generator; The Chattanooga Implement & Manufacturing Company, Chattanooga, Tenn., one 16 in. x 30 in. engine, direct connected to a 150-kw, engine-type, alternating-current generator, together with exciter, switchboard and seven standard Allis-Chalmers induction motors; W. B. Mershon & Company, Saginaw, Mich., one 12 in. x 30 in. engine, direct-connected to a 75-kw, alternating-current generator; the City of Waynesboro, Waynesboro, Ga., one engine 14 in. x 30 in., and a 125-kw, alternating-current generator.

ALUMINUM PRODUCTION.—The closing down of two of the five plants of the Aluminum Company of America follows very largely as the direct result of the present curtailment in the electrical industry. The company has five plants, located at St. Louis, Niagara Falls, Shawinigan Falls, Canada, Massena Springs and New Kensington, Pa. The two former plants are now closed. Another case contributory to the slump in the company's sales has been the temporary cessation in the orders from automobile manufacturers, who have been very large consumers of the metal as well as of sheet aluminum. For the past two years the Aluminum Company of America, which is the corporate successor of the Pittsburg Reduction Company, has been doing a record-breaking business.

ELECTRIC RAILWAY MATERIAL.—The Mexican "Diario Oficial" has printed a copy of a decree authorizing the Empresa del Ferrocarril Industrial de Puebla to import into Mexico free of duty all necessary material for converting the line to electric traction.

Financial Intelligence.

THE WEEK IN WALL STREET.—Contrary to very general expectation, the stock market continued to advance with only temporary and comparatively slight interruptions. Although on the surface considerable weakness was displayed, the undertone was surprisingly good and the turn upward again abrupt and pronounced. Union Pacific and Reading continued to attract the greatest attention, although U. S. Steel stocks, American Smelting & Refining and Brooklyn Rapid Transit were dealt in on a large scale and scored advances well in proportion to those recorded for the acknowledged leaders. The prevalent feeling in Wall Street is that normal conditions are being rapidly restored, and that the market is justified in discounting them. As to banking matters, the situation has undoubtedly improved greatly. Several cities report that the issuance of clearing house certificates for emergency currency has been suspended. Bonds were notably active, with decided rises in active issues. There were very few incidents affecting the position of particular stocks. Amalgamated Copper was quite active and developed strength in sympathy with the rest of the list, notwithstanding the absence of any favorable indications in the copper metal situation. Brooklyn Rapid Transit was something of a feature in the trading, presumably on the covering of a substantial short interest. An active business was done in Brooklyn Rapid Transit which resulted in a net gain of 6⅛ points. Westinghouse common advanced 7½ points, and General Electric made a net gain of 3 points, ex-dividend. On the curb market, trading resulted for the most part in considerable net gains, some of them being sensational. Following are the closing quotations for Dec. 10:

NEW YORK.

	Dec. 3	Dec. 10		Dec. 3	Dec. 10
Allis-Chalmers Co.	5⅞	5⅞	General Electric	115¼	112¼
Allis-Chalmers Co. pfd..	15½	16⅛	Hudson River Tel.....	—	—
Am. Dist. Tel.....	—	—	Interborough Met. com.	7	7
American Tel. & Cable..	—	—	Interborough Met. pfd.	18	18½
American Locomotive...	36¾	35½	Mackay Cos.	50¾	52⅛
Amer. Locomotive pfd.	86	87	Mackay Cos. pfd.....	60	58
American Tel. & Tel...	100½	102	Marconi Tel.	—	—
Brooklyn Rapid Transit.	35⅞	38⅜	Metropolitan St. Ry...	—	—
Electric Boat	—	—	N. Y. & N. J. Tel.....	97½	—
Electric Boat pfd.....	—	—	Western Union Tel....	58½	56
Electric Vehicle	—	—	Westinghouse com.....	46	43½
Electric Vehicle pfd....	—	—	Westinghouse pfd.....	61	—

BOSTON.

	Dec. 3	Dec. 10		Dec. 3	Dec. 10
American Tel. & Tel..	101¾	102¼	Mass. Elec. Ry. pfd...	39	38
Cumberland Telephone..	—	—	Mexican Telephone....	1¼	1½
Edison Elec. Illum.....	200	205	New England Telep...	99½	105
General Electric	116	—	Western Tel. & Tel....	—	4
Mass Elec. Ry.....	9¼	9¼*	West. Tel. & Tel. pfd..	50	52

PHILADELPHIA.

	Dec. 3	Dec. 10		Dec. 3	Dec. 10
American Railways.....	44	44	Phila. Electric	6⅛	6½
Elec. Co. of America..	8⅛	8¾	Phila. Rapid Transit....	15¼	16¾
Elec. Storage Battery..	32½	32	Phila. Traction	81	82
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Dec. 3	Dec. 10		Dec. 3	Dec. 10
Chicago City Ry.....	150*	150*	National Carbon	—	50
Commonwealth-Edison ..	78	77	National Carbon pfd...	—	99
Chicago Subway	14	13½	Union Traction	—	—
Chicago Tel. Co.....	105	108½	Union Traction pfd....	—	—
Metropolitan Elec. com.	20*	13			

*Asked.

SOUTHERN NEW ENGLAND TELEPHONE.—It is stated in New Haven, Conn., semi-officially, that following the death of President Morris F. Tyler, of the Southern New England Telephone Company, his duties and the general management of the company, under the direction of Vice-President James English, will be in the hands of a committee of the board of directors, which some months ago was appointed by President Tyler himself. The committee will consist of General Sherwin, of Boston; A. H. Robertson, Max Adler, J. T. Moran and J. W. Alling, the last four of New York. The annual meeting of the company will be held Jan. 28, and it is not likely that a new president of the corporation will be announced before that time.

THE WESTINGHOUSE REPORT.—Note was made in these pages last week of the figures of a balance sheet for the Westinghouse Electric & Manufacturing Company, as of Oct. 23, prepared by the receivers. We now give the data below:

ASSETS.

Property and plant	$12,342,223
Quick assets	2,721,839
Accounts receivable	9,210,671
Notes receivable	3,534,698
Interest accrued, not due	195,307
Working assets	17,799,465
Investments	29,490,614
Other assets	7,523,106
Total assets	$82,817,923

LIABILITIES.

Preferred stock	$3,998,700
Assenting stock	23,937,195
Non-assenting stock	600
Funded debt	20,469,000
Collateral notes	8,702,702
Current liabilities	13,462,609
Interest accrued, not due	410,528
Current accounts, special	13,375
Reserves	211,956
Profit and loss surplus	11,610,756
Total liabilities	$82,817,923

The balance sheet presented at the annual meeting held March 31 follows:

ASSETS.

Property and plant	$12,570,073
Cash	1,383,891
Accounts and notes receivable	10,443,116
Raw material	16,988,176
Completed apparatus	1,468,513
Investments	22,296,806
Charters, franchises, patents, etc	7,120,276
Total assets	$72,270,854

LIABILTIES.

Preferred stock	$3,998,700
Assenting stock	20,996,350
Non-assenting stock	1,100
Convertible bonds	15,000,000
Debenture certificates	2,278,000
Collateral notes	6,000,000
Current liabilities	11,221,890
Inventory adjustment	179,662
Profit and loss surplus	12,595,151
Total liabilities	$72,270,854

The financial community has shown itself well disposed to accept the report as conservative and well calculated to show the real condition of the corporation.

ELECTRIC VEHICLE RECEIVERSHIP.—The Electric Vehicle Company, the parent company of a large number of electric transportation companies, went into the hands of receivers in New Jersey and this city on Dec. 10, in a friendly proceeding to reorganize the concern. The action was taken on account of the default of payment of an issue of $2,500,000 6 per cent gold bonds which fell due on Nov. 1 and other obligations that recently matured. The company had a capital stock of $20,000,000. The tight money market, in which the company was unable either to borrow or collect what was due it, is given as the cause of the embarrassment. The business, it is understood, will be continued for the present by the receivers. An effort to reorganize will be made. Judge Cross, of the United States Circuit Court in Newark, appointed Halsey M. Barrett, of Newark, and Henry W. Nuckles, an officer of the company, receivers. In New York City, Judge Ward, of the United States Circuit Court, appointed Mr. Barrett and William S. Montgomery ancillary receivers. The company's business in New York City was at 134 West Thirty-Ninth Street and 621 West Forty-Second Street. The receivers took charge of both places, and also of the company's manufacturing plant in Hartford, Conn. Other indebtedness of the company is declared to consist of the issue of $2,500,000 bonds, secured by a mortgage held by the Morton Trust Company, of this city, as trustee; demand promissory notes to the amount of $591,043.32; a note for $300,000 which fell due on Dec. 3; a note for $2,600, due Dec. 27, and a note for $5,708.18, due Jan. 15, 1908; accounts payable aggregating $204,790.32, of which $150,000 has been due and unpaid since Nov. 15. Of the liabilities $2,016,000 is said to be past due. The assets are listed as the manufacturing plant at Hartford, Conn., including machinery, stock, building, and other things, with a book value of $717,498.16; office furniture, $4,731.54; finished vehicles, $173,087.73; consigned vehicles and merchandise of book or cost value of $90,387.51; patents and patent licenses of a book value of $11,447,537.28; raw materials and supplies, with parts in process of manufacture, $770,474.20; finished parts, $378,714; stocks and bonds of other corporations of a book value of $358,002; accounts and notes receivable, $132,000, and cash, $12,000. In addition, the bill mentions as an asset the item of "good will," and alleges that under this head the trademark of "Columbia" is of great value. The company is the sole owner of the noted "Selden" patent, which is used by the Association of Licensed Automobile Manufacturers, and which yields a large amount in royalties.

WESTERN ELECTRIC COMPANY.—Advices from Boston state that while the fiscal year of the Western Electric Company ended Nov. 30 last will show a decrease in gross sales of approximately $19,000,000, or 27 per cent. from the previous 12 months, there are strong internal evidences in the general telephone situation which warrant the belief that Western Electric has already passed through its period of depression and is now gaining rapidly. The opening of 1907 found the American Telephone subsidiaries generally overstocked with telephone apparatus and the large bulk of unfilled orders on the books of the Western Electric, which were worked off during the first half of the last fiscal year, tended to augment the total of over $10,000,000 telephone supplies, which the associate companies were carrying practically in storage at the beginning of 1907. As a result of the sharp curtailment in orders for telephone apparatus, the gross sales of the Western Electric, which were between 1 and 2 per cent greater for the first seven months of the 1907 year than for the same period of 1906, were but little more than half as large during the last five months of the 1907 year as during the same five months last year. The American Telephone subsidiaries which have been gradually using up idle apparatus are soon coming into the market for new supplies and these orders in themselves will be sufficient to cause a marked increase in total sales. In addition there is little doubt that the recent decision to sell telephone apparatus direct to the public is destined to lead to a very material increase in the sales of the Western Electric. On the first of January, 1907, the Central Union Telephone Company had in addition to its regular subscribers a total of 58,044 sub-licensees representing almost entirely independent companies using Bell apparatus. A few months ago, independent companies not equipped with Bell apparatus and non-competitors of existing Bell companies were generally given the privilege of becoming sub-licensees. As a result, the Central Union had on Nov. 1 a total of over 200,000 sub-licensees, an increase in 10 months of over 140,000.

BALTIMORE TELEPHONE.—The Baltimore Electric Company has sold the Maryland Telephone Company to interests said to be independent and who announce that the property will continue to be operated in competition with the Chesapeake & Potomac Telephone Company. The purchase price is said to have been about $300,000, the property being taken subject to $1,000,000 of first mortgage 5 per cent bonds and $1,155,000 of 5 per cent general mortgage bonds issued by the Maryland Telephone & Telegraph Company, the predecessor of the Maryland Telephone Company. Mr. H. P. Miller, of Columbus, Ohio, is in charge of the property, representing the new owners, and has been elected vice-president. Mr. Miller is an experienced telephone manager. As yet the organization of the company by the new interests has not been completed. A president has not been chosen, but Mr. Miller has been named as vice-president, while the directors include, in addition to him, Messrs. Joseph Taylor and F. M. Twomey, of New York, and Dudley G. Browning, of New Jersey. When the Consolidated Gas, Electric Light & Power Company leased the Baltimore Electric Company, Mr. S. Davies Warfield, chairman of the board of directors of the former, announced that it was not the intention of the Consolidated to go into the telephone business, and that negotiations had been opened with the Bell interests looking to the sale of the Maryland Company to them.

LARGE TRACTION BOND ISSUE.—The Philadelphia & Western Railway, which operates an electric line running out of Philadelphia, has filed a mortgage to the Trust Company of America as trustee to cover an authorized issue of $20,000,000 of first mortgage five per cent bonds. Of this issue only $4,000,000 are immediately issuable, the balance being reserved for extensions, improvements, or additions. All the stock of the Philadelphia & Western is owned by a syndicate of which George R. Sheldon and Mackay & Company are managers.

DIVIDENDS.—At a meeting of the directors of the Columbus, Ohio, Citizens' Telephone Company the regular 1 per cent on the common stock of the company was declared, payable Dec. 1. The directors of the Twin City Rapid Transit Company have declared a quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 2.

GENERAL NEWS

Construction News.

DADEVILLE, ALA.—An election will soon be held to vote on the proposition to issue $10,000 in bonds to improve the municipal electric light plant.

TALLADEGA, ALA.—The Alabama Power Company contemplates the construction of an electric light plant, and installing a 300-hp engine, boiler and new generator at the shoals plant. Contracts have been awarded for the machinery.

UNIVERSITY, ALA.—Bids have been asked for by the University of Alabama for the following power house equipment: Three boilers having a combined rating of 500-hp; one or two 100-kw, direct-current generators and accessories; one or two 125-hp, automatic, four-valve or Corliss engines, complete; one 25-kw alternating-current generator with exciter; a heater and separator of 500-hp rating. John W. Abercrombie is president.

LITTLE ROCK, ARK.—Plans are being made by the Southwestern Telephone & Telegraph Company for an expenditure of $1,500,000, of which $500,000 will be used in improving and extending the Little Rock service. The underground conduit system is to be greatly extended. P. K. Baker is superintendent of the local system.

BERKELEY, CAL.—C. S. Forney recently submitted a proposition to the Chamber of Commerce in regard to establishing a new electric lighting company to furnish electricity in competition with the Berkeley Electric Light & Gas Company. Mr. Forney stated that the preliminaries for the formation of the company were complete, and that it had a plant located on the bay shore near the town line, where the power house would be located.

HOLLISTER, CAL.—The Hollister Light & Power Company is planning to enlarge its electric light plant.

LONG BEACH, CAL.—Shortly after the first of the year the Edison Electric Company will expend from $100,000 to $150,000 on a new substation here.

MONTEREY, CAL.—Bids will be received until Dec. 30 by John L. Clem, chief quartermaster U. S. A., at the Presidio of San Francisco, for furnishing and installing electric lighting fixtures in a double set of non-commissioned officers' quarters for hospital corps at the Presidio of Monterey.

NAPA, CAL.—The Snow Mountain Power Company has begun work on the construction of its transmission lines in Napa County. The line will be extended to St. Helena and Calistoga without delay, and also across Napa County to make connections with lines at Santa Rosa, Vallejo and San Rafael. The company is constructing a large plant at Ukiah and will furnish electricity to Napa and surrounding counties.

OAKLAND, CAL.—It is reported that the engineers of the Great Western Power Company, which recently acquired property on Brooklyn Basin, south of Fifth Avenue, in East Oakland, are at work with the intention of preparing for the construction of a large power plant there. The company, whose principal place of business is Richmond, has filed a series of deeds of right of way with the Contra Costa county recorder, giving the concern control of a large amount of land. An electric transmission line is being built from Antioch, by way of Concord and Walnut Creek, to Oakland. The company will obtain its energy from the Sierra Mountains. Its announced purpose is to supply energy to large manufacturing plants in this part of the State, but it is rumored that the company will furnish energy for an electric ferry train service to be operated by the Western Pacific Railroad when its terminal is completed in this city. ?

REDDING, CAL.—A deed has been filed in the county recorder's office conveying to the Northern California Power Company 280 acres of land on which is situated the Manzanita Lake acquired by H. H. Noble from Albert Smith. The deed includes all water rights in the lake and all water rights acquired by Mr. Noble.

VALLEJO, CAL.—E. D. Lehe, owner of the electric lighting plants at Dixon, Wheatland, Rio Vista, Cordelia and towns in the Sacramento Valley, is planning to erect a transmission line throughout the Suisun Valley to supply the farmers with electricity. He has obtained rights of way and sufficient contracts to guarantee the success of the system.

WILLOWS, CAL.—C. H. Sehorn contemplates installing a pumping plant to be operated by a gasoline engine or an electric motor. P. R. Garrett is also arranging to install a pumping plant.

FLORENCE, COL.—Plans are being made by the local telephone company to enlarge its plant, which will involve an expenditure of about $25,000.

SALIDA, COL.—Plans are being made to increase the equipment of the local telephone system, involving an expenditure of $25,000.

BRISTOL, CONN.—The new power plant of the Bristol Manufacturing Company has been completed and put into operation. The old power plant located in the main factory will be abandoned. An auxiliary water power plant is now being constructed and will be put into use as soon as completed.

CHESTER, CONN.—The Selectmen have closed a contract with the Chester Light & Power Company to light the streets of the town. The company will furnish 13 lamps of 30 cp, three of 37½ cp and eight of 25 cp, at a cost of $601 per year.

GLASTONBURY, CONN.—The Glastonbury Power Company has awarded the contract for the construction of a large power plant on Roaring Brook in Cotton Hollow in South Glastonbury to F. T. Ley & Company, of Springfield, Mass. The cost of the plant is estimated at about $200,000, and will have an output of 1300 horse-power. Work will commence early in the spring and is expected to be completed in the fall. Electricity will be furnished for lighting and power purposes in Glastonbury, Manchester and Rocky Hill.

PLAINVILLE, CONN.—At a town meeting held recently it was voted to rescind the vote passed at a meeting held about two weeks ago instructing the Selectmen to contract with the Connecticut Company for lighting the streets of the town. The meeting voted to increase the appropriation for street lighting from $1,600 to $1,700 and to give the Selectmen power of awarding the lighting contract.

SUFFIELD, CONN.—The Village Water Company has announced that it has established a minimum rate of $1 per month. On Dec. 1 it began furnishing incandescent lamp renewals free.

DOVER, DEL.—The citizens are contemplating the installation of a 50-kw generator in the municipal electric light plant. F. T. Cooke is superintendent.

WASHINGTON, D. C.—Bids will be received at the office of Elliott Woods, superintendent of the U. S. capitol building and grounds, until Jan. 15, for equipment for the heating, lighting and power plant for the U. S. capitol and Congressional buildings, including boiler feed pumps, barometric condensers, centrifugal pumps, motors, cranes and chimneys.

JACKSONVILLE, FLA.—John G. Christopher has been awarded the contract for furnishing the feed pumps for the municipal electric light plant for $1,789.

ST. AUGUSTINE, FLA.—The City Council has awarded the contract for lighting the city to the St. Johns Light & Power Company. The cost of lighting for the city for the past year was $8,500; according to the new contract, the cost will be $6,500 for the ensuing year, saving the city a sum of $2,000.

COLUMBUS, GA.—Surveys are being made by the Columbus Power Company of its water power on the Chattahoochee River between Columbus and West Point with a view of further developments. The company is preparing to build a third hydro-electric plant for the transmission of electricity for manufacturing and other purposes. It is stated that 125,000 horse-power can be developed at the various properties. The company has two plants in operation with a combined output of 80,000 horse-power. F. E. Reidhead is manager.

LAGRANGE, GA.—The managers of the municipal electric light plant are contemplating doubling the output of the plant and increasing the number of city lamps and making other extensions to the system. J. R. Black is superintendent.

WASHINGTON, GA.—The Washington & Elberton Construction Company has filed a petition for a charter. The company will be capitalized at $75,000 and proposes to construct the projected railway between Elberton and Washington, which will ultimately be extended to Hartwell. Among the petitioners are M. M. Elkan, J. H. Blackwell, W. H. Hudson, V. E. Hudgens and others.

MILNER, IDAHO.—The Milner & North Side Railroad Company is contemplating the construction of an electric railway, 65 miles in length, which when completed will connect Milner, Jerome, Wendell and Gooding. The company plans to erect a power station at Shoshone Falls. D. C. McWaters, of Milner, is president and general manager.

CABERY, ILL.—The Cabery telephone exchange, owned by A. C. Schrader, has been sold to N. A. Watts, of Maroa, Ill., who took possession of the plant Dec. 1.

CAIRO, ILL.—O. C. Macy, manager of the Cairo Electric & Traction Company, writes that about $150,000 will be expended on improvements to its system, but nothing will be done for the present.

CHICAGO, ILL.—The Lake Shore & Michigan Southern Railway Company recently purchased a 250-kw, 240-volt, two-phase, 60-cycle Allis-Chalmers engine type generator, and a 15-kw exciter unit to increase the power equipment of the Chicago, Indiana & Southern Railway Company, a subsidiary line. The new generator will be installed at Danville.

EAST MOLINE, ILL.—Harry D. Swartz, manager of the Central Union Telephone Company, and Charles E. Knorr, representing the Electric & Gas Heating & Lighting Company, have presented to the City Council an ordinance to furnish street lighting and also for lighting the city hall.

FISHER, ILL.—It is reported that the Village Trustees have decided to purchase the local electric light plant and will make improvements to the same.

MARENGO, ILL.—We are informed that Messrs. Ripon & Fish have taken a 10-year lease of the municipal electric light plant and water works system and will take control of the plant after Jan. 1.

EVANSVILLE, IND.—The Evansville Railways of Indiana, formed to control the Evansville & Mount Vernon Electric Railway and the Evansville & Eastern companies, has filed a notice of an issue of $500,000 of capital stock. The company has projected extensions to its system aggregating 25 miles.

GARY, IND.—The contract for the construction of the Gary & Interurban Railway has been awarded to the Co-operative Construction Company, of Chicago, Ill.

INDIANAPOLIS, IND.—It is stated that the Grand Central Traction Company will soon be in the market for materials necessary for the construction of its railway. Surveys and estimates have been completed for the line, which is to connect Indianapolis and Evansville. A branch line will also be built from Bloomington, Ill., to Terre Haute, Ind. W. Duncan is chief engineer.

LIGONIER, IND.—The question of constructing a municipal electric light plant is under consideration here.

RICHMOND, IND.—The United Gas & Electric Company, of New York, N. Y., owning and controlling the Light, Heat & Power Company of this city, has submitted another proposition to the City Council to buy the city plant. The proposition includes a willingness to accept a new franchise safeguarding the city as to rates, etc. The consideration is to be based on an estimate or appraisal to be made by competent electrical engineers. The Council and Board of Public Works has the proposition under advisement.

TERRE HAUTE, IND.—The Terre Haute, Indianapolis & Eastern Traction Company has decided to furnish electric light service in the residences along the company's line west of this city. It is understood that other localities along the line will be equally favored.

WARSAW, IND.—The Wino Water & Light Company, of this city, has made a report to the City Council acknowledging the loss of $5,400 during the past eleven months. The company is willing to go into partnership with the city or sell its plants outright to the city.

DES MOINES, IA.—Judge Howe has appointed W. B. Starkey receiver of the Iowa Light & Power Company, on application of the Iowa Loan & Trust Company. The Iowa Light & Power Company was recently organized to take over the heating and lighting franchise of the Polk and Hippee interests. The appointment of a receiver is simply a formal action.

GRISWOLD, IA.—Daniel Eppelsheimer, city clerk, writes that the Griswold Light & Power Company has received a franchise to erect and maintain an electric light plant. The proposed plant will cost about $3,000. R. C. Prather and J. M. McAvoy are interested in the company.

GUTHRIE CENTER, IA.—The Guthrie Center Electric Light Company will install another unit in its plant next year. C. T. Harney is manager.

JEFFERSON, IA.—Percy Gray, manager of the Jefferson Light, Heat, Power & Water Company, writes that among the improvements contemplated are the installation of one 150-kw, three-phase alternator, 100 to 200-kw, new three-phase set, 100 to 300-hp boilers and possibly a heating plant.

PELLA, IA.—The electric plant of the Pella Electric Light & Power Company has been purchased by Henry Rhynsberger and Walter Fowler, of this city. The plant will be overhauled and put in first-class condition.

SILVER LAKE, IA.—At an election held here recently the proposition to install an electric lighting system was defeated.

LOUISVILLE, KY.—The Kentucky Electric Company contemplates the construction of a power house, to cost about $125,000. Bryan Allen is secretary.

SACO, ME.—The York Manufacturing Company contemplates the construction of a large power plant on Factory Wharf in the spring. The station will be near the wharf, where it will be possible to unload coal from the boats directly into the coal yards.

BALTIMORE, MD.—Plans are being made by the University of Maryland to erect a power house and nurses' home to cost $25,000. Sunderlin Bros. are the architects.

BALTIMORE, MD.—The Forestglen Land Company contemplates the construction of a central electric lighting and heating plant to supply light and heat to 900 double houses which the company proposes to erect in the suburbs of Baltimore. Charles F. Behrens, Calvert Building, is manager.

AYER, MASS.—The Ayer Electric Light Company has notified the Selectmen of an increase in the price for street lighting, to take effect from Dec. 1. The lamps are to be extinguished at midnight instead of one o'clock as at present, and the price of incandescent lamps increased from $15 to $17.50 per lamp per year, which will increase the cost of street lighting by more than $300 per year.

BOSTON, MASS.—The West End Street Railway Company has petitioned the State Railroad Commission for permission to issue 20,218 shares of additional common stock, as an amount necessary for payment to the Boston Elevated Railway Company for additions, improvements and alterations made from April, 1904, to Sept. 30, 1907, which amount to $2,135,750. The company also asks for authority to issue $750,000 in bonds.

BROCKTON, MASS.—The electric lighting plant of the Edison Electric Illuminating Company in East Bridgewater and the new sub-station in the city are expected to be completed and in operation about the middle of this month. The East Bridgewater plant will furnish electric energy for the sub-station in this city and the station now in use will be used as an auxiliary. Two rotary converters of 200-kw rating have been placed in the sub-station, and another one has been ordered and will be set up as soon as possible. H. A. Davidson will be chief engineer of both stations.

HAVERHILL, MASS.—The new five-year contract between the city and the Haverhill Electric Light Company has been signed by the Common Council. According to its terms the company is to furnish and maintain 200 or more arc lamps at the rate of $100 per lamp per year; and also agrees to furnish electricity for lighting the public buildings and clocks for each year of the contract, on the following schedule: 10,000 kw-hours, in any one year, at 10 cents per kw-hour; from 10,000 to 20,000 kw-hours, at 9 cents; from 20,000 to 30,000 kw-hours, 8 cents; all in excess of 30,000 kw-hours, at 7 cents per kw-hour. The contract calls for the installation of new alternating-current arc lighting system.

LEICESTER, MASS.—The Board of Selectmen is contemplating having the streets lighted from 6 to 6.30 a. m. during December and January, for the benefit of the employees in the Cherry Valley and Rochdale mills.

MERRIMAC, MASS.—A 5-hp motor has been installed at the new laundry, power for which is supplied by the municipal electric plant.

PEABODY, MASS.—At a special town meeting held Dec. 2 to vote on the proposition to make an appropriation of $55,000 for reconstructing and enlarging the electric light plant the measure was lost. It was voted to lay the matter over until the next town meeting.

SANDWICH, MASS.—A new power plant is being installed in the plant of the Alton Manufacturing Company.

CHARLOTTE, MICH.—A receiver has been appointed for the Charlotte Electric Company on application of the Union Trust Company, of Detroit, as trustee for the Guardian Trust Company, of Cleveland, Ohio, which represents the minority bondholders of a $30,000 issue, due in 1920, on which the interest payments have been defaulted.

ISHPEMING, MICH.—Extensive improvements and additions are being made to the plant of the Marquette County Gas & Electric Company, which includes the installation of a 500-kw Curtis steam turbine, a 200-hp engine direct connected to a 500-volt General Electric generator for street railway use, and a 300-hp Babcock & Wilcox boiler. Extensive additions and improvements are also being made to the gas plant. The work now under way will involve an expenditure of about $50,000.

GRANITE FALLS, MINN.—The Granite Falls Telephone Company has been granted a franchise for a local exchange.

MINNEAPOLIS, MINN.—It is reported that the Twin City Rapid Transit Company has leased and will electrify and operate that portion of the Minneapolis & St. Louis line between Manitou and Tonka Bay, Lake Minnetonka. The Twin City Rapid Transit Company will construct a mile and a half of line from its present terminus at Excelsior to Manitou, and will improve the mile and a half of the Minneapolis & St. Louis track from that point to Tonka Bay.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company has submitted a new schedule of rates to the special committee of the City Council for electrical energy, which will mean a reduction of 30 per cent over the present rates. The rates are as follows: For commercial lighting, 10 cents per kw-hour for the first 65 hours per month, and 6 cents per kw-hour for all used in excess. (Present rates are 14 and 6⅔ cents, respectively.) Residence lighting, flat meter rate of 10 cents per kw-hour for the first 52 hours per month, and 6 cents for all used in excess. (Present rates, 14 and 6⅔ cents, respectively.) For motors, 6¾ cents per kw-hour for the first 52 hours used per month; 2¼ cents per kw-hour for all used in excess. (Present rates, 7½ cents for first 52 hours, 5 cents second 52 hours and 2 cents for all in excess of 104 kw-hours.) Discounts will be allowed from the above rates as follows: Monthly bill of from $50 to $100, 5 per cent; from $100 to $150, 10 per cent; from $150 to $200, 15 per cent; from $200 to $250, 20 per cent; $250 and over, 25 per cent. For street arc lamps, $67.50 per lamp per year, for a total number of lamps not to exceed 3000. (Present rate, $84 per lamp per year.) This proposition contemplates changing the present system of street lighting to a more modern one, subject to the approval of the City Council. The above rates are made with the understanding that the company is not to receive less than $1 per month per meter for lighting service and $2 per month per horse-power demand from motor customers, except in elevator business, which will be $1 per horse-power per month of the rating of the motor.

SLEEPY EYE, MINN.—The American Electrical Company, of St. Paul, has secured the contract to install a generator in the municipal electric light plant.

HUMANSVILLE, MO.—Clayton Cavin, of Springfield, has purchased the exchange and lines of the Humansville Telephone Company, the consideration being $15,000.

KIRKSVILLE, MO.—The Fort Wayne Electric Works, of Fort Wayne, Ind., has been awarded a contract to install dynamos and other electrical machinery and equipment in the new power house in this city.

HARLOWTON, MONT.—A company is being organized here for the purpose of establishing a light and water plant. A. C. Graves and Benjamin Urner are interested in the enterprise.

PENDER, NEB.—M. M. Neumann has submitted a proposition to the Village Board to install an electric light plant. Mr. Neumann owns a small plant and proposes to install a plant large enough to light the whole village if the board will grant him a franchise for 15 years.

FALLON, NEV.—State Engineer Nicholas has issued a water right on the Truckee River to Percy Gardner. It is said that plans have been submitted to the railroad officials for the construction of a large power plant on the Truckee River near Clark's Station. The proposed site is on Southern Pacific ground.

ORANGE, N. J.—The Common Council has decided to take an appeal from the decision of the Supreme Court in the municipal lighting case. The opinion as handed down by Justice Pitney was to the effect that the city of Orange has no power to develop or to be developed from its water plant to use for the operation of a lighting plant. The city contends that the court has not taken a proper view of the situation, and it is also said that the decision was not unanimous.

HERKIMER, N. Y.—The Board of Supervisors has adopted the report of the military committee recommending that a new electric lighting plant should be installed in the armory at Mohawk.

MINEOLA, N. Y.—The New York & North Shore Traction Company has applied to the Supervisors for a franchise to construct an electric railway on the North Hempstead and Flushing Turnpike at its intersection with the Middle Neck Road.

NIAGARA FALLS, N. Y.—The hearing before the State Public Service Commission, originally scheduled for Nov. 26 on the application of the Niagara Falls Lighting Company to distribute electrical energy in Niagara Falls and Lewiston, has been postponed indefinitely at the request of the company's attorneys.

ROSLYN, N. Y.—The Public Service Commission of the Second District has granted the Nassau Light & Power Company permission to acquire the $35,000 capital stock of the Oyster Bay Electric Light & Power Company. The stock of the company was actually purchased by the Nassau Light & Power Company in 1905, without applying as required by law to the Commission of Gas and Electricity. In its petition to the Public Service Commission the company claimed that they were ignorant at the time that such consent should have been secured, and had acted in good faith in the matter.

SILVER SPRINGS, N. Y.—The question of lighting the town by electricity is now under consideration. Energy for operating the system may be secured from Lamont.

STAMFORD, N. Y.—At a special meeting of the Township Council the franchise of the Ontario Distributing Company (Boyle & Symmes) was amended in its application to rates. Under the original franchise all private service was to be on a flat rate and consumers were to make an advance to the company for the cost of building the line. As amended, the by-law provides for all service on a meter system at a rate of 7 cents per kw-hour. The township may hold to the flat rate for its street lighting, in which it will advance $500 to the company on the cost of lines.

FAYETTEVILLE, N. C.—The Fayetteville Steam Laundry is contemplating the installation of an electric plant to furnish electricity for lighting and for heating irons.

WHITNEY, N. C.—Work has commenced on the construction of the large power house of the Whitney Power Company at this place, where the Yadkin River has been harnessed and will furnish electricity to the Peidmont section of North Carolina. The plant will develop about 46,000 horse-power, a good share of which has already been contracted for by manufacturing interests. It is expected to have the plant in operation by March, 1908.

LIDGERWOOD, N. D.—A company has recently been organized, with a capital stock of $500,000, to construct an electric railway from Lidgerwood to Vebler. E. A. Movius and J. H. Movius are interested in the project.

NEW BREMEN, OHIO.—A. M. Steinbrey, village clerk, writes that it is proposed to purchase the present lighting plant and transfer the same to the water works plant.

NEWBURG HEIGHTS, OHIO.—Bids will be received uhtil Jan. 7 by P. S. Ruggles, village clerk, for furnishing materials and supplying this village with street lighting. Bids will be received as a whole or separately on material and labor.

ANADARKO, OKLA.—The City Council contemplates issuing $75,000 in bonds, the proceeds to be used to improve and enlarge the municipal electric light plant.

PORTLAND, ORE.—The Oregon Electric Railway Company has completed laying its track between Portland and Salem. It is said that a branch will be constructed within the next few months to Hillsboro and Forest Grove, and the main line extended down the Willamette Valley from Salem to Eugene. Feeders will be built throughout the valley. H. B. Clarke is president of the company.

THE DALLES, ORE.—George E. Jacobs and other Portland capitalists have purchased a water site on the Deschutes River from G. L. Rohr, who owns the property known as Rohrvilla, about seven miles from Moro. The new owners propose to develop the water power to furnish electricity for lamps and motors in the towns of Moro, Grass Valley, Wasco and The Dalles.

HAZLETON, PA.—The sub-station of the Consumers' Electric Light & Power Company, a subsidiary corporation of the Harwood Electric Light & Power Company, is completed and in operation. This station supplies electricity needed for the service in this city.

JOHNSTOWN, PA.—The City Council passed, over Mayor Young's veto, the ordinance granting the Johnstown Passenger Railway Company the right to operate in Morrellville.

LEBANON, PA.—The City Council on Nov. 25 awarded the contract for street lighting to the Edison Electric Illuminating Company for a term of five years. The company agrees to furnish arc lamps at $79.92 each per year, and incandescent lamps for $16.80 per lamp per year.

McADOO, PA.—It is reported that the Consumers' Electric Light & Power Company, of Hazleton, has offered to lease the municipal electric light plant for 25 years, and pay off the indebtedness of the plant. It is probable that it will be accepted, as municipal ownership has been a financial failure in this borough.

BROOKINGS, S. D.—The Brookings & Sioux Falls Railway will be equipped for the present with gasoline-electric cars, with a view of installing the overhead electric system when business warrants it. Neil Stewart is president and general manager.

MITCHELL, S. D.—The City Council has granted a 20-year franchise to a new company, recently formed by local men. The company proposes to buy the plant of the Mitchell Gas Company or erect a new plant, and offers a large reduction in rates. The maximum price for electricity is 10 cents per kw-hour.

SERVIERVILLE, TENN.—An election has been ordered by the court of Servierville to be held Dec. 14 to vote on the question of buying $150,000 in bonds to aid the proposed electric railway between Knoxville and Rutherford, N. C., the road to be known as the Knoxville & Eastern Railway. Preliminary surveys for the road have been completed.

DALLAS, TEX.—We have been informed that the Dallas Interurban Electric Railway Company, which is building an electric railway between Dallas, Terrell and Tyler, will resume construction work about March 1, 1908. S. A. Stemmons, secretary of the company, states that the company will probably locate its power house in Dallas. The company is capitalized at $2,400,000. D. E. Waggoner is president, and I. J. Willingham, vice-president and general manager.

HOUSTON, TEX.—Arrangements are being made by the Houston Home Telephone Company for the construction of its proposed automatic telephone system, the cost of which is estimated at $646,746. McMeen & Miller, of Chicago, Ill., have charge of the work. The system will be extended to Houston Heights, where a sub-station will be built. J. S. Slusher is president.

McKINNEY, TEX.—R. F. Dowell, city secretary, writes that the citizens on Nov. 26 voted to issue $26,000 in bonds for water and electric light extension and park work.

MT. PLEASANT, TEX.—The Mount Pleasant Electric Company contemplates the installation of a 75-kw generator direct connected. G. M. Greenspun is vice-president and general manager.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company has submitted a proposition to Mayor Bransford to install 1000 arc lamps, at the cost of $60 per lamp per year. Under the present arrangement with the company the city pays $42,336 for 588 lamps. It is understood that the offer is made on condition that the clause requiring the sprinkling and flushing of the paved streets by the railway company, as provided for in the franchise recently passed by the Council, and refused by the company, be eliminated when the new franchise asked for is granted by the Council. If the proposition is accepted, the company promises to expend from $110,000 to $150,000 for improvements to its plant to meet the increased service.

RICHFORD, VT.—Owing to the delay in receiving the equipment for its power house, the Sweat-Comings Company will probably be unable to have its electric light plant in operation before next April.

ST. ALBANS, VT.—A new storage battery is being installed in the power house of the St. Albans Street Railway Company, at a cost of $3,500.

PORTSMOUTH, VA.—The Retail Merchants' Association contemplates organizing a company to install a lighting plant. J. A. Morris and Nathan Levy have charge of the project.

COLTON, WASH.—The City Council has granted the Idaho Washington Light & Power Company, of Moscow, Idaho, a franchise to erect and operate an electric light plant in this city.

SPOKANE, WASH.—J. P. Graves, president of the Inland Electric Railway Company, recently stated that the company would extend its line from the present terminus at Colfax to Walla Walla, in the near future.

SPOKANE, WASH.—It is reported that the Big Valley Electric Railway Company, which contemplates the construction of an electric railway to connect Huntingdon, Mill Creek, Allenville, Belleville, White Hall, Reedsville and Lewistown, a distance of 32 miles, has made all surveys and secured all rights of way. The company is owned and controlled by the Juniata Valley Electric Street Railway Company, of which R. W. Jacobs is president and general manager.

TACOMA, WASH.—Henry Hewitt, of this city, has obtained important franchises from the cities of Marshfield and North Bend securing the privilege to construct and operate an electric light plant and street railway system, etc.

ALMA, WIS.—The State Railroad Commission has granted the Alma Electric Light Company permission to abolish its flat rates for service and put in force meter rates at a maximum of 10 cents per kw-hour, with a discount of 20 per cent on monthly bills of over $10; 30 per cent on monthly bills of $15, and 40 per cent on monthly bills of over $20.

MARINETTE, WIS.—The Menominee & Marinette Light & Traction Company has filed with the city clerk of Marinette a declaration to the effect that it means to surrender its franchise and take out an indeterminate franchise under the public utility law. By this action the company has prevented the City Council from granting a franchise to the Economy Light & Power Company or any of the three companies now trying to obtain a franchise from the city. The companies will now have to petition the railway for the desired franchise.

WASHBURN, WIS.—The City Council has decided to purchase the outside equipment, good will and business of the Washburn Light & Power Company. The power plant was also leased and the transfer of the entire property will be made soon. The lighting plant will be managed by a commission composed of five members appointed by the Mayor.

WATERLOO, WIS.—Jackson & Jackson, of Madison, are preparing plans for an extension to the municipal electric light plant, to cost about $10,000.

RIVERTON, WYO.—A. H. Stevenson, of Butte, Mont., and E. T. Glenn contemplate making an application to the town of Riverton for a franchise to erect and operate an electric light and power plant.

VANCOUVER, B. C.—The British Columbia Electric Railway Company is planning to develop water power on the Jordan River to generate electricity to be used on Vancouver Island.

MINNEDOSA, MAN.—Joseph Barrett, 573 Dufferin Street, Toronto, Ont., writes that the Minnedosa Power Company has awarded the contract for the construction of its power plant to the Hydro Electrical Construction Company, of Toronto, for about $80,000. Alexander Keith is president of the company.

BRANTFORD, ONT.—The City Council is considering the question of securing electrical power from the Hydro-Electric Power Commission, but in the meantime will ask for rates for street and residential lighting from the Western Counties Electric Company, Ltd., and the Grand Valley Electric Company.

NAPANEE, ONT.—The town of Napanee has applied to the Hydro-Electric Power Commission for estimates of the cost at which it can be supplied with electric energy.

MONTREAL, QUE.—The Montreal Street Railway Company has secured the right of way from its present terminus of the Black River route to a point on the outskirts of the village of St. Vincent-de-Paul. A 50-year franchise has been obtained for an extension through Notre Dame-de-Grace. The company has also purchased an additional right of way on the Cartierville line.

SHERBROOK, QUE.—The City Council contemplates the construction of a municipal electric light and power plant in the near future. Plans and specifications are being prepared by Ross & Holgate, of Montreal.

Company Elections.

SALISBURY, N. C.—At a meeting of the directors of the Whitney Power Company the resignation of President George I. Whitney was presented and accepted. Vice-president Edward F. Buchanan, member of the firm of A. O. Brown & Company, was elected to succeed Mr. Whitney. The following directors resigned: J. D. Finley, C. S. Ritchie, J. B. McClelland, A. W. Herron and F. L. Stephenson, and are succeeded by G. L. Stout, L. G. Young, W. D. Sargent, J. S. Henderson and A. O. Brown. The Whitney Power Company is developing about 50,000 horsepower on the Yadkin River, near Yadkin, N. C., and contemplates developing 50,000 additional horse-power later.

New Industrial Companies.

THE BANKERS' ALARM PROTECTION COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $3,000, for the purpose of manufacturing and dealing in electrical appliances. The incorporators are Ole Jacobsen, George English and Enos T. Welant.

THE DAVIS ELECTRIC COMPANY, of Parkersburg, W. Va., has been organized to manufacture an electrical medical battery invented by Jesse R. Davis. J. Menton Caldwell is president.

THE ILLINOIS ELECTRIC RENOVATOR SALES COMPANY, of Chicago, Ill., has filed articles of incorporation, with a capital stock of $15,000, for the purpose of manufacturing and selling renovators. The incorporators are A. E. Lake, M. Poffinberger and F. J. Haake.

THE LUXENBERG'S ELECTRIC PROTECTIVE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $5,000, by Jacob Luxenberg, Abraham Luxenberg and Henry Tannebaum.

THE MACCALLEN COMPANY (electricians), of Boston, Mass., has been incorporated, with a capital stock of $300,000, by Thomas Allen, Louis MacCarthy and Gardner W. Prouty.

THE POWER EQUIPMENT COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $10,000, by Orrington C. Foster, A. C. Field and others.

THE GEORGE H. RICE COMPANY, of Brooklyn, N. Y., has been incorporated, with a capital stock of $40,000 and the following directors: George H. Rice, John J. Holshuh and Thomas H. Harvey, all of Brooklyn. The company proposes to carry on an electrical engineering business.

New Incorporations.

SOLDIER, IDAHO.—The Soldier Telephone Company, Ltd., has been incorporated with a capital stock of $4,800. The directors are Frank Housman, A. G. Barker, D. H. Gwinn, W. Y. Perkins and James King.

CENTRALIA, ILL.—The Centralia & Sandoval Railway Company has been formed by the owners of the Centralia & Central City Traction Company, for the purpose of constructing an extension from the present terminus of the line to Sandoval, a distance of four miles, to serve the mining district. Work on the construction of the road will probably begin about April 1. E. R. List is president.

CHICAGO, ILL.—The Interstate Automatic Telephone Company has been incorporated, with a capital stock of $10,000, by C. J. Huff, T. A. Hall and V. H. Huff. The Indiana office of the company is at Hammond.

GILLESPIE, ILL.—The Gillespie Electric Railway Company has been incorporated, with a capital stock of $30,000, for the purpose of building and operating an electric railway from Gillespie to the mines in Macoupin County. The incorporators and the first board of directors are H. Y. Bycroft, R. H. Isaacs, H. W. Rice, G. W. Schmidt, S. P. Preston, all of Gillespie.

JERSEYVILLE, ILL.—Articles of incorporation have been filed for the Improved Electric Railway Company with a capital stock of $200,000. The directors are H. H. Bowman, S. L. Hill, Dr. A. A. Shobe, William J. Herman, William Embly, P. M. Hamilton, all of Jerseyville, and William J. Hamilton, of Evanston.

LITTLETON, ILL.—The Littleton & Brooklyn Mutual Telephone Company has filed articles of incorporation, with a capital of $1,000. The incorporators are Herman Yaap and others.

TONTI, ILL.—The Tonti Telephone Company has been incorporated with a capital stock of $500 by John H. Kretzer, Walter Cope and Jacob Hershberger.

BLACK HAWK, IND.—The Pierson Mutual Telephone Company has filed articles of incorporation, with a capital of $2,000. The company will build a telephone system in this town and western part of Vigo County. Charles Yaw, B. F. Beard and S. C. Elliott are the directors.

HARLAN, IND.—The Harlan Telephone Company has filed articles of incorporation with a capital stock of $25,000. The company has purchased the plant of the Harlan Telephone Company (partnership). The officers of the new company are J. H. Zimmerman, of Harlan, president, and Frank Dalrymple, of Hicksville, Ohio, secretary.

SHELBYVILLE, IND.—The Shelbyville Gas Company has been formed to take over the Shelbyville Gas & Light Company and will enlarge and rebuild the plant.

COLONY, KAN.—The Colony & Carney Telephone Company has filed articles of incorporation with a capital stock of $1,100. The incorporators are James Suttles, of Colony; C. S. Kern, of Kern; W. T. Motley, and Frank Nelson, of Boise.

BAY'S FORK, KY.—The Bay's Fork Telephone Company has been incorporated by A. Welch, Daniel H. Read, J. A. Read and R. A. Read.

LANCASTER, KY.—The Kentucky Telephone & Telegraph Company has been incorporated with a capital stock of $10,000 by J. W. Elmore, H. V. Bastin, H. T. Logan, James I. Hamilton and Frank B. Marksbury.

MONTICELLO, KY.—The Monticello & Cumberland Telephone Company has been incorporated with a capital stock of $2,000.

PORTLAND, ME.—The Rio de Janeiro Telephone Company has been incorporated with a capital stock of $1,000,000. J. E. Manter, of Portland, is president, and C. E. Eaton, also of Portland, is treasurer.

DAGGETT, MICH.—The Daggett-Nathan Telephone Company has been incorporated with a capital stock of $1,000 by Paul Perrizo, Jr., C. W. Wilkins, Eugene Houte, Dr. D. R. Landsborough, Charles Erickson and Peter LaCroix.

PORT HURON, MICH.—Articles of incorporation have been filed for the Port Huron Citizens' Telephone Company, with a capital stock of $200,000, by Charles Greer and others.

CLARISSA, MINN.—A new telephone company has been formed in this place to install a rural telephone line. George A. Etzel is secretary.

FOREST, MINN.—The Fox Lake Rural Telephone Company was formed recently to erect a telephone system in this place.

MONTICELLO, MINN.—The Gilchrist Lake Rural Telephone Company has been formed and will build a line in the spring. Arthur Hoar is secretary.

ST. LOUIS, MO.—The Baden Power Company has filed articles of incorporation, with a capital stock of $2,000. The object of the corporation is to manufacture, distribute and deal in electric, steam and hydraulic power. The incorporators are Robert Gaylord, of Chicago; George S. Gaylord, of Evanston, Ill.; James A. Seddon, Warren D. Harris and Samuel B. McPheeters.

BROOKLYN, N. Y.—The Inter-City Telephone Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $250,000 and the directors are: Frederick G. Ashley, Albert W. Linton, Thomas B. Stevenson.

NEW YORK, N. Y.—The Kage Light Company has been incorporated with a capital stock of $1,000 by Harry A. Gordon, Harry M. Markson and William Jasie.

OGDEN, N. Y.—The Ogden Telephone Company has filed articles of incorporation with a capital stock of $25,000. The directors are Frank C. Blackford, of Adams Basin; Charles H. Gallup, of Parma, and Lewis W. Adams, of Ogden.

BURLINGTON, N. C.—The Burgrahaw Traction Company has been incorporated with a capital stock of $250,000 for the purpose of manufacturing and distributing electricity and gas to Burlington, Graham and Haw River, N. C.; also to equip and operate a street railway in the above places and to connect them.

KING, N. C.—The Farmers' Quickstep Telephone Company has been chartered, with a capital of $25,000, by S. F. Tillotson and others.

LIBERTY, N. C.—The Liberty Telephone Company has been incorporated with a capital stock of $10,000 by J. L. Hardin, M. J. Reitzel, J. F. Pickett and others.

SANBORN, N. D.—The Barnes County Telephone Company has been incorporated in this State, with a capital stock of $25,000, by D. F. Siegfried and others.

NEVADA, OHIO.—The Nevada Telephone Company has been incorporated, with a capital stock of $30,000, by A. Swartz and others.

ALDEN, OKLA.—The Alden Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The directors are H. S. Sturgis, C. J. Carpenter, of Alden; E. H. Stewart, of Carnegie, and Fred Beasted, of Sayre.

CHATTANOOGA, OKLA.—The Comanche Telephone Company has been incorporated with a capital stock of $5,000 by T. E. and F. O. Hibbard, of Snyder, and W. S. White, of Mt. Peck.

DUKE, OKLA.—The Hollowman Coraha Independent Telephone Company has been incorporated with a capital stock of $3,200. The incorporators are: J. H. Hollowman and Frank D. Franks, of Russell; W. D. Branson, James D. Moore, Calvin G. Hukill and N. D. Tennison, of Duke.

GUTHRIE, OKLA.—The Shawnee-Tecumseh Telephone Company has been incorporated with a capital stock of $100,000. J. W. Rubey is president of the company.

OKLAHOMA CITY, OKLA.—Articles of incorporation have been filed for the Columbia Electric Company with a capital stock of $25,000 by A. J. McMahan, of Oklahoma City; Arthur V. Allen and A. C. Allen, of Chicago, Ill.

PORTLAND, ORE.—Articles of incorporation have been filed for the Portland, Eugene & Eastern Railway Company with a capital stock of $1,000,000, for the purpose of building an electric railway from Portland to Salem, Eugene, Yaquina, Prineville and Ontario, with branches to numerous towns. The total mileage contemplated is more than 800 miles. It is proposed to develop the water power of the Mackenzie, the Santiam and the Deschutes rivers and streams in central Oregon to generate electricity to operate the system planned. The incorporators are J. O. Story, J. C. Bracher, George A. Welch, E. M. Hall and John McNary.

BEAVER FALLS, PA.—The Beaver Falls & Koppel and the Beaver & Lawrence Electric Railway Companies have been chartered in the Beaver County courts. The Beaver & Lawrence line will run from North Sewickley to Beaver Falls and the Beaver & Koppel Railway will extend from Beaver Falls to Koppel, a distance of 10 miles. The incorporators are T. P. Simpson, S. L. Tone, C. W. Gibbs, W. J. Horgan and B. S. Johns.

EASTON, PA.—Articles of incorporation have been filed for the Clymer Power Company by Leo S. Clymer and B. F. Fackenthal. The company proposes to manufacture gas and electricity.

CLOVER, VA.—The Piedmont Telephone Company has been organized with W. H. Dorin president, Dr. R. H. Fuller vice-president and G. B. Gibson secretary and treasurer.

SHAW LAKE, WIS.—The Bashaw Valley Telephone Company has been incorporated, with a capital stock of $10,000, by A. E. Allen, J. M. Smith and Eugene Smith.

HAILEYBURY, ONT.—The Silver Belt Electric Railway Company has been granted a charter to construct an electric railway from Latchford north to Cache River.

Legal.

AWARD APPROVED.—By a decision rendered Dec. 2, the Circuit Court sustained Judge Charles M. Rogers in his finding that the Columbus Board of Public Service, of Columbus, Ohio, legally could award a contract for turbines for the municipal light plant to the Allis-Chalmers Company. A test suit was filed by City Solicitor George S. Marshall at the request of the Westinghouse Company, which claimed that the Allis-Chalmers turbines had not been in operation for two years, as required in the specifications.

RIGHT TO OWN LIGHT PLANT.—Justice Dowdell, of the Supreme Court, has handed down an opinion that the town of North Birmingham, Ala., has no right to own and operate an electric lighting system. Such an authority exceeds that given by the constitution or any act. L. R. Posey sued for personal injury at the plant, being denied a verdict because of the failure of the town to secure authority to own a plant. In affirming the lower court, Justice Dowdell says: "Our conclusion is that the defendant had not the power under the general statute, which contained all of the charter powers, to engage in the operation of an electric light plant. It follows that the act was ultra vires and resulting injury fixed upon the corporation no liability."

Obituary.

MR. LOUIS J. TOWNSEND, of Berwick, Pa., died Nov. 30, after a long illness. He was manager of the Berwick Electric Light Company and identified with various interests in the town. He was a prominent Mason and was 37 years old.

MR. M. F. TYLER.—We regret to note the sudden death of Mr. Morris F. Tyler, one of the pioneers in modern electrical industries, and president of the Southern New England Telephone Company. The cause of death was apoplexy. Morris Franklin Tyler was born in New Haven, Aug. 12, 1848. His father, Morris Tyler, was a wholesale manufacturer of boots and shoes in New Haven, who served his native city as Councilman, as Alderman and as Mayor, and his State as Lieutenant-Governor in 1871 and 1872. The son studied at Yale University, where he was graduated A. B. 1870, A. M. 1873 and LL. B. 1873. Adopting the profession of law he was admitted to the bar immediately after taking his bachelor degree at Yale University Law School. He opened a law office in New Haven, July 1, 1873. His early political affiliation was with the Republican party, but the incidents attending the campaign between the Republican candidate for President, James G. Blaine, and Grover Cleveland, the candidate of the Democratic party, led him to vote with the Democrats, and from that time he had remained independent in politics. In March, 1883, he was elected president of the Southern New England Telephone Company, and the great growth of this enterprise occurred under his management. He served as executive secretary to Governor Hobart B. Bigelow, of Connecticut, in 1881and 1882. He was instructor in jurisprudence in Yale University, 1893-94; full professor of law, 1894-99, and treasurer of the corporation, 1899-1904. He was a member of the Union League, Grolier and Yale clubs, of New York City, and of the Quinnipiack and Graduates' Club, of New Haven. Mr. Tyler was a man of strong personality and keen judgment. He had strong views upon the subject of the obligations to the public by these corporations, and was the first president of one of them, the Southern New England Telephone Company, to issue new stock to stockholders at a figure considerably in advance of par, thus anticipating legislation of that import. He was a lover of literature and nature, a professional man by education and a corporation manager by choice. He was married Nov. 5, 1873, to Delia Talman, daughter of Victor Gifford and Georgiana Audubon, of New York City, and of the five children born of this marriage four are living. The children living are Victor Morris Tyler, secretary of the Southern New England Telephone Company; Ernest Franklin Tyler, an artist in New York City; Leonard Sanford Tyler, and Audubon Tyler.

Personal.

MR. W. J. MOORE, assistant professor of electrical engineering at the Stevens Institute of Technology, has resigned in order to accept a professorship in the North Carolina State College of Agriculture and Mechanical Arts.

MR. JAMES N. COX, who for several years has been superintendent of the Nashville district of the Cumberland Telegraph & Telephone Company, has resigned his position to become general manager of the Gainesboro Telephone Company.

MR. OLIVER M. DIALL, superintendent of the Lockport Gas & Electric Company, has been appointed general manager of the Lockport Light, Heat & Power Company, which is a consolidation of the former company and the Economy Light, Fuel & Power Company. The new company will take charge Jan. 1.

PROF. W. E. GEYER, head of the physics department at the Stevens Institute of Technology, and Prof. John B. Webb, the professor of mathematics and mechanics, have been retired on the Carnegie Foundation. Prof. Geyer was the first occupant of the chair of applied electricity when established in 1884.

MR. CHARLES BLIZARD, third vice-president of the Electric Storage Battery Company, read a paper on "Development in Storage Battery Practice" before the Telephone Society of New York on Nov. 26. The subject is one with which Mr. Blizard enjoys a most intimate familiarity, from long experience in all departments.

MR. SOICHIRA SHIMUDZU, who has for the past three years been in the engineering department of the Allis-Chalmers Works at Cincinnati and Milwaukee, will shortly sail for Japan, where he will take a position on the engineering staff of the Shibaura Engineering Company, one of the many important interests of the celebrated Mitsui family.

SAWYER-PIKE.—The marriage took place at Cleveland, Ohio, on Dec. 4, of Mr. Leroy P. Sawyer, manager of the Buckeye Electric Company, with Miss Jessamine A. Pike, daughter of Mrs. L. D. Pike, at whose residence the ceremony was performed. Among those present were Messrs. Willits Sawyer, of New York; Ernest Houghton, of Chicago, and B. G. Tremaine, H. A. Tremaine, F. S. Terry and S. E. Doane, of the National Electric Lamp Company. The happy pair will visit Texas, Louisiana and Nebraska and make their home in Cleveland in January.

MR. WILLIAM E. GRIFFIN has been appointed general superintendent of the Rochester Railway Company and its connecting lines. Mr. Griffin has been identified with the Rochester and Eastern Rapid Railway Company from the time work was started on the road, five and one-half years ago.

The management of the Ontario Light & Traction Company will pass out of the control of the officials of the Rochester & Eastern Rapid Railway Company, and Mr. S. P. Cobb, of Rochester, who has been constructing engineer for the Canandaigua Gas Light Company, will be made superintendent of the lighting companies.

MR. WILLIAM CRICHTON, for many years well known all over the United States as representing the interests of the Hart Manufacturing Company, of Hartford, Conn., and who established the English branch of the business in London, which has been so entirely successful under his care, has arrived on the *Lusitania* for a visit to the United States of some weeks' duration. Mr. Crichton has been in England for three years and has succeeded in establishing the Hart switch in many of the very best hotels and public buildings in that country, where the quality of goods is appreciated more than the price. Mr. Crichton will be a good deal in Hartford during his stay, but will also visit New York City and his own family in Washington, and will doubtless have an opportunity also of seeing many of his old acquaintances.

MR. WM. B. HALE, who is well known to electrical engineers in Chicago and elsewhere through his former connection with the Western Electric Company, is now located in Mexico as a consulting electrical engineer, making a specialty of examining and appraising existing properties and estimating on projected electrical engineering work in Mexico for American and other investors. Heretofore those in the United States interested in Mexican propositions have been obliged to send an expert the long journey to Mexico to look over the ground and make a report, with considerable resulting delay and expense. Mr. Hale has been in Mexico for several years and was for some time general manager of the telephone company in Mexico City. From his wide engineering experience, knowledge of the Spanish language and familiarity with the country, he is in an excellent position to furnish trustworthy reports on engineering matters in Mexico. He is also prepared to supervise electrical installations in any part of the republic. His offices are 1 A Independencia, No. 6, City of Mexico.

Trade Publications.

ARC LAMPS.—Circular No. 1092, of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., treats of enclosed arc lamps designed for use on constant-voltage alternating circuits.

RAILWAY MOTORS.—Direct-current railway motors, rated at 40 hp and 500 volts, are fully described in Circular No. 1089 of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

WATT-HOUR METER CALIBRATORS.—Bulletin No. 1097, of the Fort Wayne Electric Works, Fort Wayne, Ind., is devoted to portable calibrators for watt-hour meters, full instructions for the use of these instruments being given.

"INSULATINE."—The Insulatine Company, of 1 Broadway, New York City, has just issued a small pamphlet relative to its waterproofing and electrical sealing cements, paints and compounds, which are set forth therein in detail.

GAS PRODUCERS.—Section III of Catalogue A, of the Wile Power Gas Company, Rochester, N. Y., gives an excellent discussion of the advantageous features of gas for engine fuel, and describes machinery for producing gas by the suction process.

RAILWAY CAR CONTROL.—In its circular No. 1091 the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., gives an extended illustrated description of the unit-switch system of multiple control for governing the various motors of a train simultaneously.

AIR BRAKES.—Emergency valves for straight air-brake equipments are fully dealt with in Bulletin No. 1515 of the Allis-Chalmers Company, Milwaukee, Wis. Pneumatic governors for maintaining the supply of air at the required pressure are described in Bulletin No. 1514 of the same company.

NELSON VALVES.—The Nelson Valve Company, of Chestnut Hill, Philadelphia, has just issued a handsome large octavo catalogue and price list "H" in paper cover giving a good deal of data as to its improved gate and globe valves for steam, water, gas, air and ammonia. There are 52 pages of text.

STEAM TURBO-GENERATORS.—An elaborately illustrated description of Curtis steam turbo-generators has been issued by the General Electric Company, Schenectady, N. Y., as Bulletin No. 4531. The bulletin contains information concerning the constructive details of both the turbines and the generators.

AUTO TRANSFORMERS FOR LAMP CIRCUITS.—Single-coil transformers for maintaining equal voltages in three-wire and five-wire circuits when the supply is obtained from a two-wire circuit are discussed fully in Circular No. 1081 of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

GAS ENGINES.—The Lazier Gas Engine Company, 190 Main Street, Buffalo, N. Y., has issued an attractive catalogue, together with numerous blue-prints, devoted to its vertical gas engines of the multiple-cylinder type. It is stated that a hp-year produced by the simple steam engine costs $52.36, while if produced by gas engines, it costs $16.94.

GAS AND GASOLINE ENGINES.—Bulletin D, of the Jacobson Machine Manufacturing Company, Warren, Pa., has for its subject the Jacobson gas and gasoline engine as built for stationary and portable use. The description of the principles of action of this type of engine and of its constructional details is well written and is unusually complete.

ELECTRIC CONTROLLER & SUPPLY COMPANY, of Cleveland, Ohio, has issued a booklet, 6 by 3¼ inches, devoted to electric drive and to the application of magnetically operated unit switches to the control of motors that are frequently and rapidly reversed. The text is clearly written, accompanied by good illustrations, and the get-up of the pamphlet in imitation leather cover is neat and artistic.

LAMP FIXTURES.—The Nernst Lamp Company, Pittsburg, Pa., has issued a well-prepared catalogue devoted to an extremely neat line of lamp fixtures. In the design of these fixtures great care has been exercised to make them scientifically correct for the best distribution of light and, at the same time, to follow out the best artistic treatment of the day. The aim has been to obtain plain, lasting elegance rather than elaborate ornamentation.

CHASE-SHAWMUT COMPANY, of Newburyport, Mass., has issued bulletin and price list No. 101 descriptive of its stage lighting appliances of the "Cushing" type. It is small and convenient in form, and clear in its information, and should be of service to all interested in these matters. It is one of a series issued by the company. Its immediate predecessor, No. 100, deals with National Electrical Code fuses, cut-outs and fittings, railway cut-out boxes, pocket test lamps, etc.

INCANDESCENT LAMPS.—The Franklin Electric Manufacturing Company, Hartford, Conn., has published Bulletin No. 4, giving convincing arguments concerning the merits of Novi anchored-filament lamp and Femco reflector lamp. In the latter lamp the reflector is a part of the lamp itself and is not a separate adjunct, and the light in a downward direction is greatly multiplied. It is stated that the light in the useful direction is thereby increased more than 100 per cent.

ARC LAMPS of the enclosed direct-current type intended for operation on constant voltage circuits are illustrated and described in Bulletin No. 1099, of the Fort Wayne Electric Works, Fort Wayne, Ind. The lamps are designed for either 110 volts or 220 volts; in the former case the current may range from 4.5 to 5.5 amperes, and in the latter from 2.75 to 3.5 amperes. Bulletin No. 1101, of the above firm, deals with the "multiple" system of street arc lighting using enclosed type of alternating-current lamps.

ELECTRIC CONTROLLING DEVICES.—With the title, "The Navy Bulletin," the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued a 48-page pamphlet designed for the information of manufacturers of electric motors and motor-driven machinery who supply apparatus to the Navy Department. The Cutler-Hammer company has made a special study of this branch of the electrical industry, and the pamphlet illustrates various types of controlling apparatus of its manufacture which are purchased by the several naval bureaus.

WATER TUBE BOILERS.—The Rust Boiler Company, Pittsburg, Pa., has issued in pamphlet form a report by Prof. Wm. Kent of a series of tests on a Rust water-tube boiler. At full load of 335-hp the boiler was found to have an efficiency of 75.5 per cent, while at a load of 700-hp the efficiency was 69 per cent. Prof. Kent stated that the efficiency results were within three per cent of the highest that are theoretically possible with Pittsburg coal in any boiler fitted with any kind of stoker, and not provided with an economizer.

THE BRISTOL COMPANY, of Waterbury, Conn., has issued three new bulletins, covering its electrical instruments: Bulletin No. 61 describes recording voltmeters, which is in 12 pages, illustrated, and is very complete; Bulletin No. 62 describing recording ammeters, lists a new form of portable instrument, which is now being manufactured, and is very attractive in its make-up. Bulletin No. 63 covers a line of recording wattmeters and is somewhat larger than the others, having 19 pages. This bulletin, besides illustrating the new portable form of wattmeter, also shows a very complete list of single, two-phase and balanced three-phase alternating-current instruments, something that was absent from former bulletins. These catalogues will be appreciated by engineers, who are usually in a quandary as to the best type of instrument applicable to the loads for which they intend to design, and will be found very helpful by them.

FRICTION CLUTCHES.—A friction clutch designed for the heaviest work, with particular regard for simplicity, durability and ease of adjustment, is described in Allis-Chalmers Company's Bulletin No. 4001, entitled "The Reliance Friction Clutch." All the usual objections have been overcome, it is said. Ordinarily, for example, the pulley hub of a friction clutch is cut down to economize space on the shaft, and the bearing surface supplied will not properly carry the strain of a tight belt. The strain of the Reliance friction clutch, on the contrary, has a very even distribution, it being made with either three or six arms, arranged in sets of three. Each of the sets is connected with an equalizing ring by toggles, and this ring is free to move sideways, so as to equalize the strain on the three arms. The pressure, also, instead of being regulated with springs, can be set according to the load the clutch has to carry, by means of adjusting nuts and eye-bolts.

WEST SHORE RAILROAD.—The electrification of the West Shore Railroad between Utica and Syracuse has been closely watched. Special attention has been attracted to it on account of its 60,000-volt transmission line, the adoption of an inverted, protected third-rail, and the hydro-electric development from which power is supplied. In Bulletin No. 4546 the General Electric Company, Schenectady, N. Y., has issued a handsomely bound pamphlet of 24 pages, in which the installation is very completely described. The bulletin is profusely illustrated with views

of the trains, interior of the cars, transmission lines, exterior and interior of sub-stations, plans of the buildings and wiring diagrams and details of the track construction. Not the least interesting feature of the pamphlet is a comparison of two train sheets, one showing the operation before electrification and the other after, where the increase in traffic with the same track capacity is very strikingly shown. The bulletin cannot fail to be of interest to all steam railroad engineers as well as those actively engaged in electric traction.

ALLIS-CHALMERS ENGINES.—The Allis-Chalmers Company, of Milwaukee, is issuing a bulletin on "Compound Corliss Engines," which contains, besides illustrations of each type, many facts of interest to power users throughout the country. "So far as we are aware," it is stated, "the first compound Corliss engine designed for power purposes was built in the shops of this company, and to our Mr. Edwin Reynolds, who for nearly half a century has been so prominently identified with the history of this type, should be given credit for introducing the principle of compounding into general Corliss engine practice. The earliest Corliss engine was built in 1848, and twenty-eight years later the famous 'Centennial' engine, which was supposed to embody in its design and construction the very highest development of the engine builder's art, was nothing more than a pair of simple engines. The first Reynolds-Corliss engine, built in 1877, marked the beginning of an epoch in the history of the steam engine. The first compound Reynolds-Corliss was built three years later and is still in regular operation."

DIRECT CURRENT INDICATING INSTRUMENTS.—Direct current indicating instruments, Type D, manufactured by the General Electric Company, Schenectady, N. Y., are constructed upon the well-known D'Arsonval principle, and designed for switchboard use. Bulletin No. 4552, recently issued by the company, describes and illustrates their construction, and gives dimension diagrams of instruments and shunts, full-sized views of the scales, and data regarding catalogue numbers, capacities, prices, etc. Damping is obtained by means of Foucault currents generated in an aluminum frame on which the coil is wound. The magnets are carefully hardened and aged, and an unusual high torque, combined with light moving elements and small magnetic air gap, make reasonable the manufacturer's claim of long life with continued accuracy. The frame is pivoted in a jewel bearing, and the whole assembled in a round cast-iron case, which protects it from stray fields and renders the instrument dust-proof. The standard finish of Type D instruments is dull black with raised portions of polished copper.

Business Notes.

THE R. THOMAS & SONS COMPANY has moved its New York offices to 227 Fulton Street, Glackner Building, where it has fitted up fine offices and a sample room for its well-known wares on the tenth floor. The home office of the company is at East Liverpool, Ohio.

WILE POWER.—The Wile Power Gas Company, manufacturer and engineer of producer gas installations, has moved its general offices from the Cutler Building, Rochester, N. Y., to its works at 1688-92 Columbus Road, Cleveland, Ohio, where all communications in future should be addressed.

THE CENTURY ELECTRIC COMPANY, of St. Louis, has increased its business to such an extent this year that it has found it necessary to move to very much larger quarters. The middle of this month it will move to Olive and Nineteenth Streets, where it will occupy the entire building, which will quadruple its present space and facilities. The offices and the shipping department will take up the first floor and the other three floors and the basement will be devoted wholly to manufacturing purposes.

ALLIS-CHALMERS MOTORS.—Messrs. Bray and Kates, Arlington Heights, Ill., have recently purchased Allis-Chalmers electrical machinery for a small lighting and power plant, in which is included a 50-kw engine type direct-current generator and a line of the new type "K" direct-current motors, recently put on the market, the largest being 30 horse-power. The growing demand for direct-current motors to be applied to the individual drive of various machines has led to a number of important changes in both mechanical and electrical design of the motors formerly used. The type "K" motor has been developed to meet the requirements of individually motor-driven machines. It is manufactured in thirteen different frame sizes and for each size there are a number of ratings, the output of a given frame being proportional to the speed. Type "K" motors are suitable for all classes of work where either a constant or variable-speed direct-current motor is required. For general driving of machinery or for variable-speed work, shunt-wound machines are used. For cases where a large starting torque combined with the constant speed characteristic of the shunt motor is required, compound-wound motors can be furnished. For crane and hoisting service, series wound motors are supplied.

OLD ENGINES.—The proof of excellence for all things is service, whether it be the wise provisions of a policy which have brought desired results, or the design and workmanship of a line of engines. Allis-Chalmers engines have been in service over a quarter of a century, and yet so well are they built for their work that reports like the following are not by any means unusual. In October, 1895, a 26 in. x 48 in. Allis-Chalmers engine was erected and started for the Memphis Street Railway Company, Memphis, Tenn., which ran for 22 hours out of the 24 for six years without one cent for repairs. At the end of this period new cup leathers were furnished for the vacuum pots and they continued to run for six years more, when new exhaust valve stems were furnished and a new packing rim. The Kennedy Valve Manufacturing Company, of Elmira, N. Y., has had an Allis-Chalmers engine, 14 in. x 42 in., in service for eight years during which time it cost three cents for repairs, and the engine is in as good condition to-day as when it was purchased. The Wauconda Flour and Feed Mills, of Wauconda, Ill., have had an Allis-Chalmers Reynolds Corliss 12 in. x 36 in. engine in service 27 years, which runs quietly and gives good service every day. In the Carthage municipal light plant of Carthage, Mo., two Allis-Chalmers Corliss engines of the girder type, 16 in. x 36 in., speed 120 r.p.m., have been in service almost eight years, and are still in fine condition with almost no repairs. These engines, it is stated, have made 120 revolutions per minute every night in the year for eight years without intermission.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 3, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

872,324. MAGNETIC WEDGE; S. R. Bergman, Lynn, Mass. App. filed April 10, 1907. Covers wedge devices for retaining conductors in slots in the core structures of dynamo-electric machines.

872,349. MOTOR-CONTROLLING SYSTEM; John D. Hilder, New York, N. Y. App. filed July 28, 1905. Motor-controlling system adapted to the operation of electric motors, particularly for hoisting motors in which the motor is frequently started, stopped and reversed.

872,351. MANUFACTURE OF CALCIUM CARBIDE, ETC.; J. Critz King, St. Catharines, Ontario, Canada. App. filed Jan. 5, 1904. The

872,324.—Magnetic Wedge.

production of calcium carbide by passing it through a zone of fusion and discharging the reduced product therefrom as a pig, so that the pig is devoid of crust.

872,352. ELECTRIC FURNACE; J. Critz King, St. Catharines, Ontario, Canada. App. filed Jan. 5, 1904. Relates to modifications of the above.

872,400. ELECTROMAGNETICALLY-OPERATED MECHANISM; Johan M. Andersen, Boston, Mass. App. filed Jan. 20, 1906. Relates to electromagnetically-operated mechanism for effecting the operation of remote devices through a single pilot circuit.

872,432. ELECTRICAL APPARATUS; C. J. Klein, New York, N. Y. App. filed March 18, 1907. Has a push-button switch adapted for use as a molding switch and a removable connecting member, whereby the switch may be installed within a wall box.

872,474. ELECTRICAL MEASURING INSTRUMENT; W. E. Sumpner, Birmingham, England. App. filed Oct. 19, 1905. A power-factor indicator to show the phase relation between the current and voltage in an alternating-current circuit, whether it is single phase, two phase or three phase.

872,513. OIL SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed July 30, 1904. Relates to double-throw switches of the type employed in starting alternating-current motors or any other circumstances where a definite sequence of circuit connections is required; designed to prevent the making of the connections in the wrong order.

872,515. AUTOMATIC MOTOR CONTROL APPARATUS; G. H. Hill, Schenectady, N. Y. App. filed May 21, 1906. Provides means whereby the intervening device for controlling the automatic operation of a controller is made flexible, so as to automatically adjust itself to meet the requirements of different load conditions.

872,523. GRAB-BUCKET HOIST APPARATUS; S. H. Libby, East Orange, N. J. App. filed March 7, 1906. Means for controlling the motors which operate the holding and closing ropes. Designed to simplify the control apparatus and render the operation of the hoist convenient and certain.

872,524. HOIST-CONTROLLER; S. H. Libby, et al., East Orange, N. J. App. filed March 7, 1906. Relates to modifications of the above.

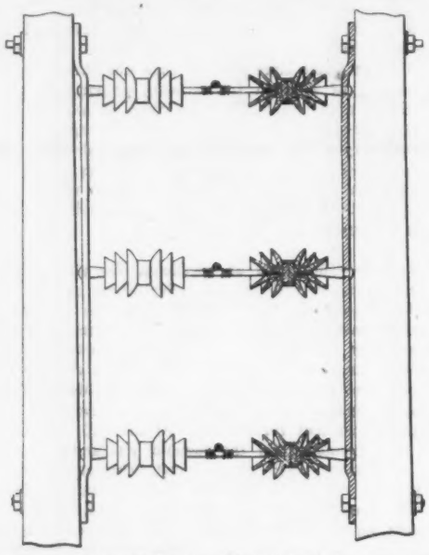
872,535. FREQUENCY CHANGER; Jakob E. Noeggerath, Schenectady, N. Y. App. filed Dec. 4, 1905. In combination, two alternating-current circuits of different frequencies, two rotary converters, one supplied with alternating-current from one of said circuits and the other supplying alternating-current to the second circuit, and electrical connections between the direct current to the other.

872,549. CURRENT-CONVERTER; Leonard Wilson, Schenectady, N. Y. App. filed Jan. 4, 1906. In combination, an inverted rotary converter, an alternating-current generator mechanically connected to said converter and having its armature in series with the alternating-current side of the converter, and means for independently varying the field strengths of both machines.

872,550. INDUCTION MOTOR; Ernest F. W. Alexanderson, Schenectady, N. Y. App. filed Nov. 9, 1905. In combination with an induction motor, means for connecting the primary winding of the motor for producing simultaneously two different numbers of poles, the secondary of said motor being arranged to offer a low resistance path for currents induced by the greater number of poles and a high resistance path for current induced by the smaller number of poles.

872,559. ALTERNATING-CURRENT MOTOR; Friedrich Eichberg, Berlin, Germany. App. filed Dec. 18, 1905. The method of operating a single-phase motor of the commutator type which consists in starting the motor by short-circuiting the armature through brushes displaced from the line of primary magnetization and supplying to the armature through brushes displaced substantially 90 electrical degrees from the short-circuiting brushes a current adapted to produce a magnetic field displaced from the primary magnetization and after the motor is up to speed bringing the armature short-circuit and primary magnetization into line.

872,563. CONTROL SYSTEM; G. H. Hill, Schenectady, N. Y. App. filed Nov. 27, 1905. Provides means whereby when one or more



872,569.—System of Insulation for High-Voltage Electric Conductors.

motors of a system is eliminated from a circuit, the control system shall be changed so as to give the most advantageous operation of the remaining motors.

872,569. SYSTEM OF INSULATION FOR HIGH-VOLTAGE ELECTRIC CONDUCTORS; F. M. Locke, Victor, N. Y. App. filed April 9, 1907. Vertical rods are fixed between horizontal cross-arms and embody separate spool-like structures of petticoated porcelain.

872,570. RAILWAY SWITCHING AND SIGNALING APPARATUS; W. Macomber, Buffalo, N. Y. App. filed March 15, 1904. Mechanism of the type adapted to cause alternate actuation of a part by successive closures of a circuit.

872,572. ELECTRIC METER CASE AND SUPPORT; Thomas E. Murray, New York, N. Y. App. filed July 13, 1907. Provides a meter case and support adapted to prevent induced energy from being obtained without recording on the meter dial.

872,581. ALARM APPARATUS; L. W. Pennington, Worcester, Mass. App. filed Dec. 15, 1905. An apparatus for producing either an audible or visual alarm upon the movement of one of its members, which may be produced by the turning of a door knob or a similar actuation.

872,613. RAILWAY SIGNALING AND APPARATUS; F. L. Dodgson, et al., Buffalo, N. Y. App. filed Nov. 27, 1905. A train-stop device for applying air brakes if an engineer passes a danger signal, or in case of any breakdown in the mechanism or the cessation of line current.

872,623. INDICATING DEVICE; W. A. Hall, Lynn, Mass. App. filed June 6, 1906. Means for indicating the circuit conditions of an electrical transformer or regulator of the type in which certain coils or turns of the transformer are cut in or out by a rotary switch mechanism.

872,631. AUDIBLE WARNING SIGNAL FOR RAILWAY CROSSINGS; C. D. Anderson et al., Louisville, Ky. App. filed May 27, 1907. Makes use of special contact plates adjacent to the track rails and engaged by a depending brush carried by the motor trucks.

872,656. ELECTRICALLY HEATED CAN CAPPING MACHINE; M. H. Johnson, Utica, N. Y. App. filed April 5, 1907. Can capping machine in which joints are welded by an electric current.

872,670. METERING PANEL BOARD; A. C. McWilliams, Chicago, Ill. App. filed May 8, 1906. Panel boards for office buildings adapted to enable the operating electrician to connect the various consumption circuits with the supply mains or bus-bars through any desired meter.

872,674. SAFETY GUARD FOR TROLLEY WHEELS; F. J. Nolan, New York, N. Y. App. filed Nov. 26, 1906. Patentee arranges a sheet metal hood of inverted V-shape overhanging trolley wire.

872,684. MOTOR-CONTROL SYSTEM; W. J. Richards, Norwood, Ohio. App. filed April 29, 1907. Motor-control system specifically adapted to "three-high rolling mills" where it is necessary to receive and support the material to be rolled.

872,708. INDUCTION-MOTOR; Bernard A. Behrend, Norwood, Ohio. App. filed Aug. 31, 1906. In a rotor, a laminated core, conductors located in said core, short-circuiting rings for said conductors, said rings having integral fan blades extending therefrom toward and into engagement with the end laminæ of the core, and means for clamping the rings and laminæ together.

872,713. SIGNALING SYSTEM; C. W. Coleman, Westfield, N. J. App. filed June 22, 1906. Provides means for actuating a signal by liquefied gas and will thus increase the number of operations of the signal that can be obtained from a given stored supply of gas.

872,720. CONTROLLER OPERATING MECHANISM; C. Fleming, Norwood, Ohio. App. filed Jan. 31, 1907. A controller for electric motors comprising fixed and movable contacts, means which, when released, tends to move the movable contact to "off" position, and two locking devices for said means.

872,724. SYSTEM OF DISTRIBUTION; E. M. Gerry, Norwood, Ohio. App. filed Oct. 19, 1905. Means for automatically regulating the field excitation of a synchronous machine in response to a change in the power factor of the circuit to maintain the power factor constant.

872,756. INSULATOR; F. C. Scherer et al., Columbiana, Ohio. App. filed Oct. 19, 1906. A two-part insulator having a ledge to receive a conductor and having a threaded cap retaining said conductor in the groove.

872,759. ELECTROLYTIC SHIP BOTTOM PROTECTOR; J. H. Schoenberger et al., Allegheny, Pa. App. filed Sept. 14, 1906. Means for electrically protecting the outside of a ship's bottom without sheathing the same, by the use of electrodes.

872,798. SIGNALING SYSTEM; C. W. Coleman, Westfield, N. J. App. filed May 1, 1906. Provides means for actuating a signal by liquefied gas that will avoid leakage of the gas and thus increase the number of operations of the signal that can be obtained from a given stored supply of gas.

372,802. TROLLEY; G. Ehmann, Canton, Ohio. App. filed June 19, 1906. The harp of the trolley wheel is swiveled on a vertical axis on the pole by a ball-bearing connection.

872,824. ELECTRIC TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed March 16, 1905. Means to translate current reversals into Morse characters and relay said characters on a second line.

872,829. ELECTRIC CIRCUIT CONTROLLER; H. W. Leonard, Bronxville, N. Y. App. filed June 1, 1903. Provides an automatic release which is adapted for the movable levers of switches, rheostats, etc., under abnormal conditions. Relates to mechanical details.

872,878. ELECTRODE; B. J. Winsom, Virginia City, Nev. App. filed Oct. 3, 1906. Relates to electro-metallurgical apparatus having positive terminals used in the precipitation of precious metals from cyanid or like solutions.

872,893. ELECTRIC DAMPER REGULATOR; J. D. Bowne, New York, N. Y. App. filed Nov. 15, 1906. Damper regulators of the type having an electric motor as the operating means, said motor being adapted to control the movement of the damper and also throw an electric switch affecting the motor circuit.

872,898. TROLLEY HARP; J. L. Chase, Ayer, Mass. App. filed July 18, 1907. The trolley harp has integral upwardly extending ears which have a function to guide the wheel against leaving the wire.

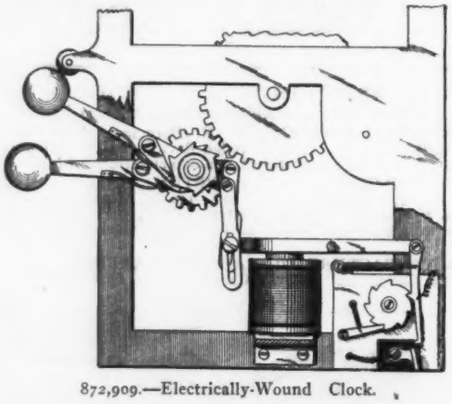
872,909. ELECTRICALLY-WOUND CLOCK; Arie De Vos, Minneapolis, Minn. App. filed Sept. 10, 1906. Construction of clock having weights which are intermittently raised by electro-magnets.

872,936. TUNGSTEN ELECTRIC INCANDESCENT LAMP; John A. Heany, York, Pa. App. filed Jan. 19, 1905. A mount for refractory metallic filaments comprising a stem with suitable lead-in wires and a support mounted upon said stem and comprising a plurality of short conductors to connect a plurality of fine hair-pin filaments in series at one end thereof, a plurality of fine resilient spiral supports at the other end thereof to engage each hair-pin filament and additional intermediate steadying means for the filaments.

872,938. SYSTEM OF CONTROL; G. H. Hill, Schenectady, N. Y. App. filed Oct. 31, 1904. System of motor control adapted for systems embodying a plurality of motors arranged to be grouped in various relations. Has means whereby the entire number of motors of the system may be grouped in series and in different ways so as to avoid supplemental resistance.

872,939. SYSTEM OF MOTOR CONTROL; G. H. Hill, Schenectady, N. Y. App. filed April 7, 1906. Relates to modifications of the above.

872,985. ART OF PRODUCING ALUMINUM AND OTHER METALS; H. S. Blackmore, Mount Vernon, N. Y. App. filed Sept.



872,909.—Electrically-Wound Clock.

23, 1904. Process of producing metal which consists in exposing a substance containing a metal and oxygen to electrolysis, while employing an electrode containing a carbide of a different metal decomposable thereby and capable of liberating the metal therefrom.

872,991. CONTROL APPARATUS; A. T. Crocker, Schenectady, N. Y. App. filed Jan. 9, 1905. Provides means for limiting and checking the movements of the controller drum in accordance with circuit requirements by means of electrically operated ratchets and detent devices acting thereon.

872,993. INSULATOR; A. S. Deem, Reading, Pa. App. filed July 6, 1907. A cleat insulator having two parts, one of which has depressions in its face, and the other of which has projections adapted to force the wire into said depressions.

12,727. HYGROMETER FOR REGULATING HUMIDIFYING AND HEATING SYSTEMS; Stuart W. Cramer, Charlotte, N. C. App. filed Sept. 3, 1907. An automatic humidifier having a wet and a dry bulb thermometer, and electrical connections whereby differences in the mercury level complete certain circuits.